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THESIS

ECONOMIC EVALUATION OF VOICE RECOGNITION (VR) FOR THE CLINICIANS' DESKTOP AT THE NAVAL HOSPITAL ROOSEVELT ROADS (NHRR)

by

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September, 1997

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ECONOMIC EVALUATION OF VOICE RECOGNITION (VR) FOR THE CLINICIANS' DESKTOP AT THE NAVAL HOSPITAL ROOSEVELT ROADS (NHRR)

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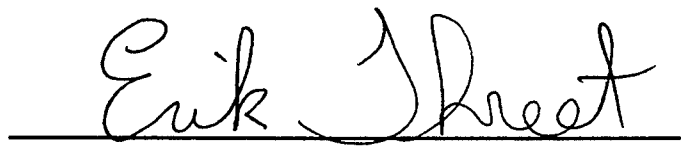
Author: 

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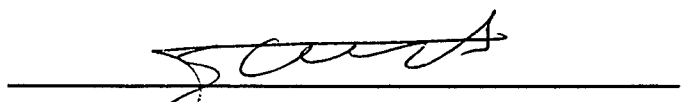
Approved by: 

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ABSTRACT

Beyond keyboards, mice, trackballs, and other means to communicate with computers, the spoken word remains the ultimate, if not elusive, user interface. Recent developments in hardware and software have brought the ability to control a computer with the spoken word closer to reality. This thesis investigates the current status of VR technology, its use in support of Joint Vision 2010, its use in the Healthcare environment and provides an analysis of the VR Pilot Project at NHRR. The objective of the analysis is to determine the viability and economical benefits of using a Commercial Off-The-Shelf (COTS) VR application as a clinicians input device for transcribing clinical encounter (SOAP) notes. The VR application used in this study was the DragonDictate Classic Edition with the DragonMed add on module for healthcare professionals.

The results show that VR technology is a viable tool that can add numerous economical benefits, such as, a decrease in the time clinicians spend transcribing SOAP notes, eliminates the need to hire medical transcriptionists and reduces Graphical User Interface (GUI) overload for Window's based Navy Medical Standard systems. In addition, findings indicate that the use of computer technology, during clinical encounters, has no significant effect on patient/clinician relationships.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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I acknowledge and thank Lieutenant Rich Riggins and Lieutenant Mike Green for planting the seed that became this project. Your ability to bring together teams and projects guides the progress of the next generation technologies and will ultimately advance the way the military utilizes Information Technology.

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I. INTRODUCTION

A. INTRODUCTION

Voice Recognition (VR) is one of the most demanding technologies in the field today. With VR, users can reduce the use of the mouse and the number of keyboard strokes. Papers will be written by the computer, not typed by the human as the software converts voice into data that the computer can understand. Generally speaking, VR lets a user communicate with a computer through voice instead of fingers. This will reduce the time that is wasted when typing because many of our thoughts can not be converted onto paper fast enough. By the time we get half of our ideas down on paper, we forget the other half...

VR technology has actually been around since the mid-1980's, but the products were inaccurate, cost thousands of dollars and required specialized systems such as IBM RS6000 workstations. Times, and technology have changed. Nowadays, new voice recognition products work under Windows and OS/2 on standard Personal Computers (PCs) as a result of improved recognition algorithms, and powerful computer processing units and digital signal processors.

Healthcare organizations all over the country have been trying to persuade clinicians to adopt electronic medical record-keeping and directly enter patient data into computers. This step would save on transcription costs and make reports available to other providers almost immediately. Various studies have shown that dictated medical records are better than handwritten records. [Ref. 1, pp. 29-31] Unfortunately, most

clinicians have resisted the decision to use a keyboard instead of dictating or handwriting medical encounter notes. VR companies are now offering keyboard-phobic clinicians another alternative to the keyboard. In addition, the VR companies claim that the technology can provide various economical benefits to healthcare organizations.

B. OBJECTIVE OF THESIS

The primary objective of the this thesis is to utilize VR technology as an input device for the clinician desktop. The test and evaluation of VR in an outpatient setting at the Naval Hospital Roosevelt Roads (NHRR) will provide the Navy Medical Department with a concept that could ultimately bring automated transcription services to every Navy clinician's desktop. VR will allow the clinician to dictate clinical data from outpatient visits directly into the computer workstation. The research questionnaires and experiments for this thesis were designed to collect data to address the following proposed research questions:

- What is VR? What are the primary advantages and disadvantages of VR?
- What is the perception of VR technology within the Navy's Medical Department?
- What are the hardware and software requirements for establishing a VR system?
- What are the costs and benefits of implementing a VR system as an input device in the Family Medical Center at NHRR?
- What skills are necessary to implement a VR system?
- What maintenance skills will be required to maintain the VR system?
- What is the impact in terms of staff and equipment?

- Does VR decrease the overall time a clinician spends transcribing and documenting clinical encounters?
- Do VR transcribed SOAP notes increase the thoroughness of patient charts?
- What is the impact on patient satisfaction when a clinician uses computer technology during clinical encounters?
- To what extent did the use of the computer enable the clinician to spend more time addressing patients problems and concerns?
- What impact does computer technology have on the clinician providing preventive maintenance and/or education to the patient?
- What effect did voice recognition technology have on the patient/clinician relationship?
- Is the DragonDictate Classic Edition with the DragonMed add-on adequate for use by Medical Professional?
- Does the VR pilot project at NHRR meet the Military Health Service System open architecture requirements?

These questions will be addressed through the data collected from the NHRR's VR pilot project as well as findings provided from other Navy voice recognition project efforts described in this thesis. The answers to these questions will provide the basis for developing a framework to evaluate the significant economical benefits of VR that may increase efficiencies in patient care.

C. THE SCOPE OF THE THESIS

This thesis will review the current status of VR technology, its use in support of Joint Vision 2010, its use in the Healthcare environment and provide an analysis of the VR pilot project at NHRR. The goal is to determine the economical benefits of using a Commercial Off-The-Shelf (COTS) VR application as a clinician's input device for

Electronic Medical Records (EMR), navigating through existing Navy medical standard systems and to evaluate patients' reactions to clinicians use of computer technology during clinical encounters. The pilot project will incorporate a desktop workstation comprised of a 486 or Pentium PC, with network connection to a central file server and CD-ROM towers. The input device for the clinician will be the DragonDictate Classic Edition with the DragonMed add on module for healthcare professionals. This will allow the clinicians to dictate clinical data from outpatient medical encounters directly into the EMR.

D. METHODOLOGY

The methodology used in this thesis includes a literature review, consultation with Navy VR project personnel, and a case study. The literature review consists of:

- A MEDLINE Literature index search of VR subjects through the National Library of Medicine.
- A Hospital Literature index search of VR subjects through the National Library of Medicine.
- A Computer Select database search of VR subjects at the Naval Postgraduate School Library.
- An IEEE database search of VR technology subjects at the Naval Postgraduate School Library.
- Review of various studies, reports and other documentation related to VR projects and issues, both within the DoD and the private sector.

The consultation efforts consist of:

- Collaboration with Naval Medical Information Management Center project officers on Navy Medical VR plans and initiatives.
- Attendance at the 1996 Healthcare Information and Management Systems Society Conference.

- Collaboration with Naval Health Research Center Medical Information Systems and Operations Research project officers on VR plans and initiatives.

The case study methodology consists of:

- Developing a VR pilot project perception questionnaire instrument.
- Developing a VR pilot project patient satisfaction questionnaire instrument.
- Developing a VR pilot project participant interview instrument.
- Developing a VR pilot project log to capture daily statistical recognition information.
- Developing a VR pilot project medical encounter narrative scenario instrument.
- Collaboration with the NHRR's VR pilot project officer on project requirements and objectives.
- Evaluation of project data collected from all of the instruments.

This case study focuses on specific technology and management issues in implementing a VR system at an individual site. It is not the intent of this case study to generalize the conclusions obtained here and apply them to other situations. As Robert Yin states in *Case Study Research Design and Methods*:

> Case study conclusions are generalizations to theoretical proposition and not to populations or universes... In this sense a case study does not represent a 'sample' and the investigator's goal is to expand and generalize theories (analytic generalization) and not to enumerate frequencies (statistical generalization). [Ref. 2: pp. 18-32]

E. ORGANIZATION OF THESIS

This thesis is composed of six chapters. This chapter provides the introduction, objectives, research questions, scope and methodology employed to conduct the research. Chapter II provides a detailed background on VR history, technology, equipment

standards and types of VR systems. Chapter III describes some past and current VR initiatives in the DoD and private sector. Chapter IV describes the NHRR's VR pilot project. Chapter V discusses the NHRR's VR pilot project findings. Chapter VI provides the conclusion, summary and recommendation for future research.

II. OVERVIEW OF VOICE RECOGNITION TECHNOLOGY

Beyond keyboards, mice, trackballs, and other means to communicate with computers, the spoken word remains the ultimate, if not elusive, user interface. The ability to interact with computers by voice has been a fictionalized ideal-probably best portrayed in the television show, Star Trek. But recent developments in hardware and software have brought the ability to control a computer with the spoken word closer to reality. This technology is called voice recognition (VR). VR technology, also called Automatic Speech Recognition (ASR), allows users to communicate with computers using voice instead of the traditional keyboard or mouse.

A. HISTORY OF AUTOMATIC SPEECH RECOGNITION

In the early 1930's, a Hungarian scientist, Tihamer Nemes, requested permission for a patent to develop an automatic transcription system using the optical sound tracks of movie films. The sound tracks served as a source for capturing speech sound patterns. The system would identify the sound sequences and print them out. The request for a patent was labeled "unrealistic" and denied.

It took another thirty years before the first machine capable of recognizing speech was built at AT&T Bell Laboratories. [Ref. 3: pp. 637-642] The system compared stored reference patterns (called *templates*) of the ten English digits with utterances of individual digits. It required extensive tuning to recognize the speech of a person, but once that was accomplished, its accuracy could be as good as 99%. The hope of early researchers at

Bell Laboratories, RCA Laboratories, and elsewhere was that speech recognition would be straightforward and easy.

By the mid-1960's, most researchers realized speech recognition was far more subtle and intricate than they had anticipated. Accepting the fact that spoken language transcription was not on the horizon, they narrowed their focus to speech systems capable of handling *speaker dependencies*, *word speech flow* and/or *vocabulary size*. These speech recognition systems will be discussed in the latter part of this section.

The recognition systems of the 1960's also began to incorporate time normalization techniques to minimize differences in the speed with which a person might speak. They no longer sought exact or near-exact matches. Instead, they tried to identify the reference pattern whose acoustic patterns most closely resembled the input. Later systems employed minimum matching thresholds to prevent incorrect recognition when the difference between the input and the best reference pattern was too great. Subsequent research programs at IBM and Carnegie Mellon University focused on continuous speech recognition, but the fruits of that work would not be seen until the 1970's and later.

The early 1970's saw the development of the first speech recognition product, the *VIP 100* system from Threshold Technology, Inc. Threshold Technology was one of the first to apply time-normalization to speech recognition. The *VIP 100* demonstrated the viability of small vocabulary, speaker dependent, discrete-word recognition technology. It won a US National Award in 1972.

These initial successes piqued the interest of the Advance Research Projects Agency (ARPA) of the United States Department of Defense. ARPA propelled speech recognition research towards large vocabulary, continuous speech recognition and helped

precipitate the industry's *artificial intelligence* period. Developers focused on designing *speech understanding systems* that tried to emulate the spoken language comprehension capabilities of human listeners. Systems began to incorporate modules to analyze word structure (lexical knowledge), sentence structure (syntax), meaning (semantics), and social behavior (pragmatics). ARPA's Speech Understanding Research project (ARPA SUR) was the largest of the 1970s projects. The project lasted from 1971 to 1976. It required systems to recognize: (*i*) a vocabulary of one thousand words or more, (*ii*) connected speech input, and (*iii*) the speech of several cooperative speakers. [Ref. 4: pp. 1345-1336] The ARPA SUR systems had a profound effect on the course of speech recognition research and development.

The results of ARPA SUR helped redirect the focus of research towards robust statistical models including the Hidden Markov models (HMM's) and language models. This orientation characterized work of the late 1970's and the 1980's. During the 1980's, speech recognition was buoyed by continued ARPA funding (later called DARPA and then called ARPA again) and the growth of the personal computer. Personal computers made it possible to create relatively inexpensive products and tools for rapid application development. The increased PC processing power of the late 1980's fostered the integration of sophisticated algorithms into commercial products.

The latter half of the 1980's witnessed dramatic growth in the technological sophistication of statistical techniques for speech recognition. By the end of the decade, HMM's had become almost universal. IBM's work on statistical language modeling (particularly *N-gram models*) formed the basis for language models found in all commercial, large vocabulary, dictation systems of the late 1980's and early 1990's.

A major focus of the 1980's and early 1990's was on the design of large vocabulary systems. In 1985, one thousand words was still considered a large vocabulary, particularly for commercial systems. In 1986, Speech Systems, Inc. introduced the first very large vocabulary commercial system. Their *PE100* was a twenty thousand word, phoneme-based, continuous speech, speaker-independent system running on UNIX workstations. By the end of the 1980's, Dragon Systems, Inc. had introduced a speaker-adaptive, discrete-word system able to support a vocabulary of thirty thousand words. IBM and Kurzweil AI soon followed with versions of large vocabulary systems.

The trends of the 1980's continued into the 1990's. Large vocabularies became the norm. This forced companies who sold systems in the 1980s that cost thousands of dollars but contained less than one hundred words to offer products with thousands of words for less than one hundred dollars. Subword modeling was extended to telephone applications, and more products began offering speaker-independent recognition. [Ref. 5: pp. 725-728] In 1994, Philips Dictation Systems marketed the first PC-based, very large vocabulary dictation system with a continuous natural language *free flow approach* to speech recognition. (This system allows the dictator's speech to be recorded by a computer on a local area network. Next, the recorded file is forwarded to a Speech Recognition Client Server and processed by the Phillips speech recognition software engine. This system is similar to the traditional dictation system, the only difference is that it uses a computer instead of a Dictaphone.) At the other end of the spectrum, commercial speech recognition residing on single chips and chip sets made consumer product application development a reality.

The pace of commercialization quickened. Companies began to integrate speech recognition into products ranging in size and function from VCR programmers to air-traffic control training systems. In an effort to integrate speech recognition into software products and technology, Dialogic, Novell, and Microsoft sponsored efforts to create application programming (API) standards for speech recognition. The standards committees attracted support from outside the speech recognition industry, including Intel, Digital Equipment Corporation, NEC, Siemens, Tandem Computers, and the Centre National d'Etudes des Telecommunications.

Research to improve statistical processing continued into the 1990's as well and was accompanied by a growing emphasis on developing intelligent, *spoken language understanding* systems. The complex human factors issues related to speech recognition began to unfold, moving the industry towards better human factors design.

1. Speech Recognition Process

In the speech recognition process, the main method is to compare digital patterns of single words with stored digital copies of words to come up with a "*best match.*" Figure 1 depicts the fundamental structure of a typical speech recognition system. [Ref. 6: p. 9918] The "front-end" processing extracts a parametric representation or input pattern from the digitized input speech signal using the same techniques that are used in speech analysis/synthesis systems (e.g., linear predictive analysis or filter). These acoustic features are designed to capture the linguistic features in a form that facilitates accurate linguistic decoding of the utterance.

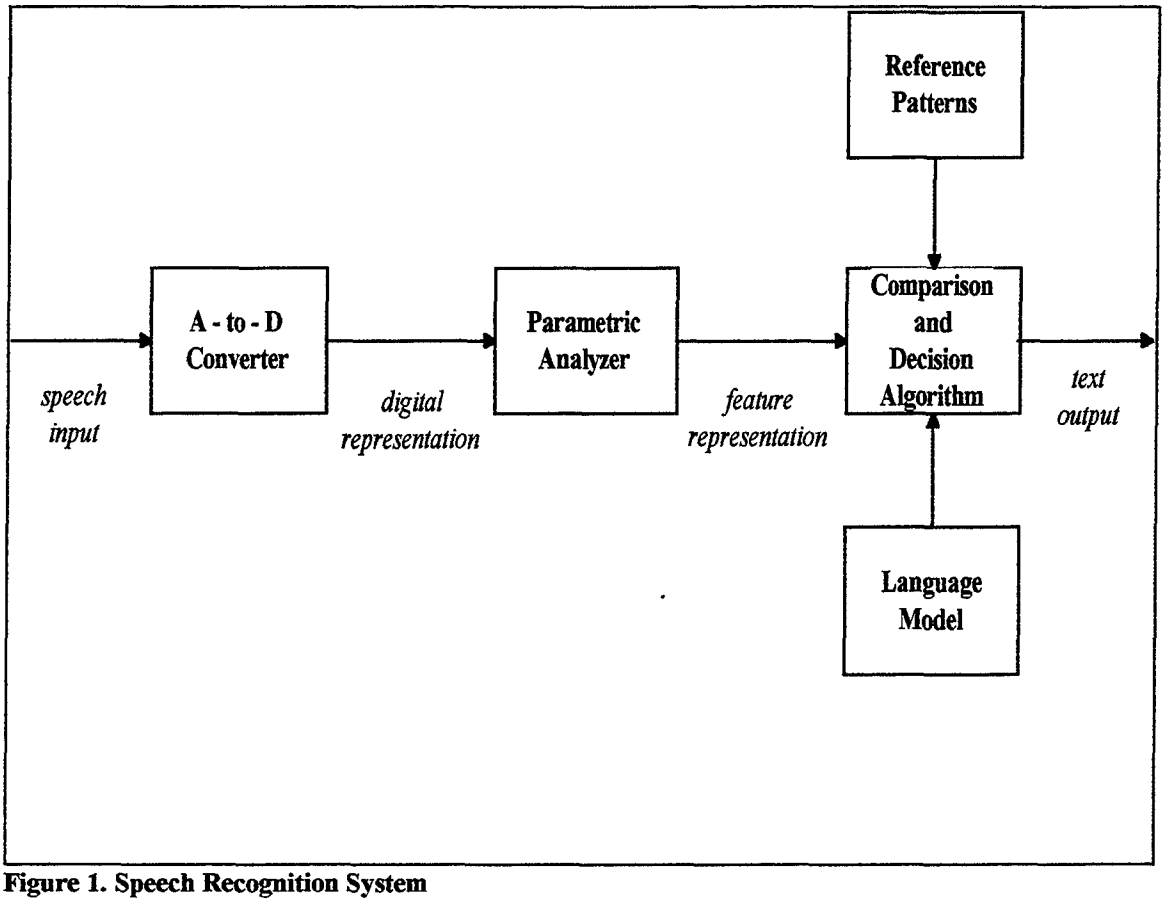

Figure 1. Speech Recognition System

According to David B. Roe, a researcher at AT&T Bell Laboratories, the speech recognition process is as follows: "the speech recognition process consists of three components: a structural model, a statistical variability model, and the synthesis of the speech signal." [Ref. 7: pp. 167-168] The recognition process begins by converting the speech signal into a sequence of feature vectors. This conversion reduces signal variability due to changes in pitch, etc. Given the sequence of feature vectors, the recognition process is reduced to a search over all possible events (word sequences) for that event which has the highest probability given the sequence of feature vectors, based on the structural and statistical variability models used in the synthesis, see Figure 2. [Ref. 7: pp. 167-168]

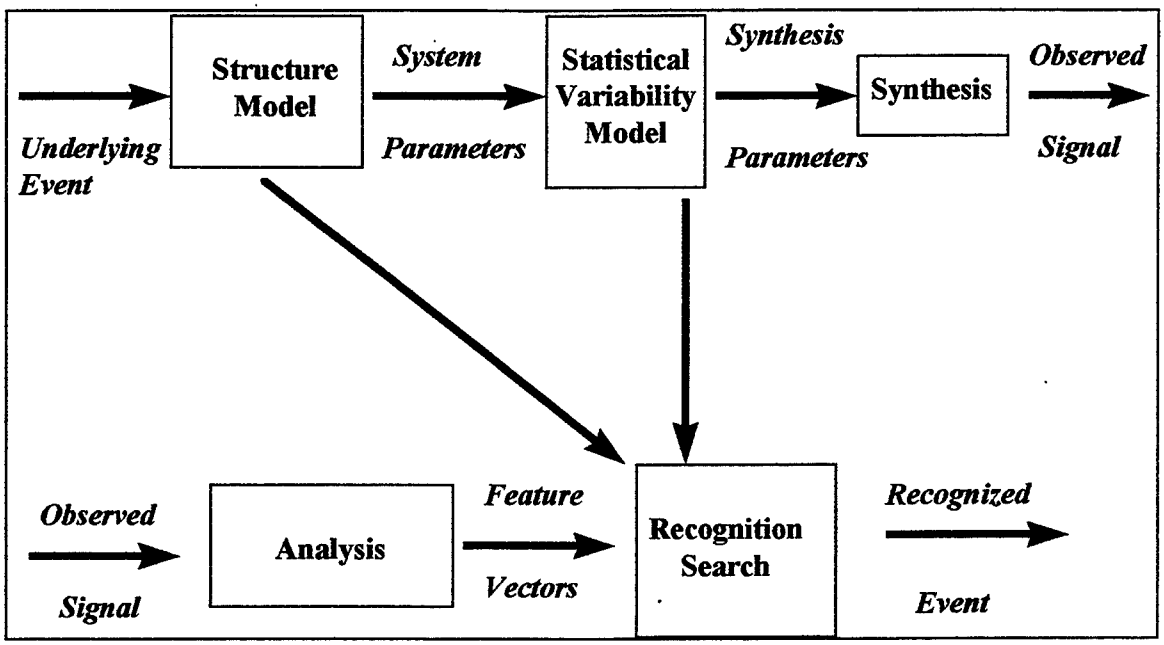

Figure 2. Speech Recognition Process

2. Speech Recognition Algorithms

Today, the most popular stochastic recognition method is based on the statistical model HMM. The term stochastic refers to the process of matching a sequence of *non-deterministic* selections from among sets of alternatives. The HMM is used to tie acoustic information together into words, sentences, and languages. "For the HMM-based recognizer, the process of turning speech sounds into text consists of determining which HMMs have the highest probability of correctly matching the user's acoustic models." [Ref. 8: p. 109] Figure 3 shows an example of a three-state HMM for a single phoneme. This HMM consists of a sequence of states connected by transitions. The states represent the alternatives of the stochastic process and the transitions contain probabilistic and other data used to determine which state should be selected next (The term *stochastic* refers to the process of making a sequence of *non-deterministic* selections from among sets of alternatives). The states in Figure 3 are displayed in circles and

transitions are represented by arrows. In the transition from the first state, the algorithm can specify that the HMM go to the first state (called a *recursive transition*), to the next state, or to the third state of the HMM. If the HMM in Figure 3 is a stored model of the word "Erik," it would be *reference model* for "*Erik*" and would contain statistics about all the spoken samples of the word used to create the reference model. Each state of the HMM holds statistics for a segment of the word. Those statistics describe the parameter variation that were found in samples of the word. A recognition system may have numerous HMM's, like the one in Figure 3, or may consolidate them into a network of states and transitions.

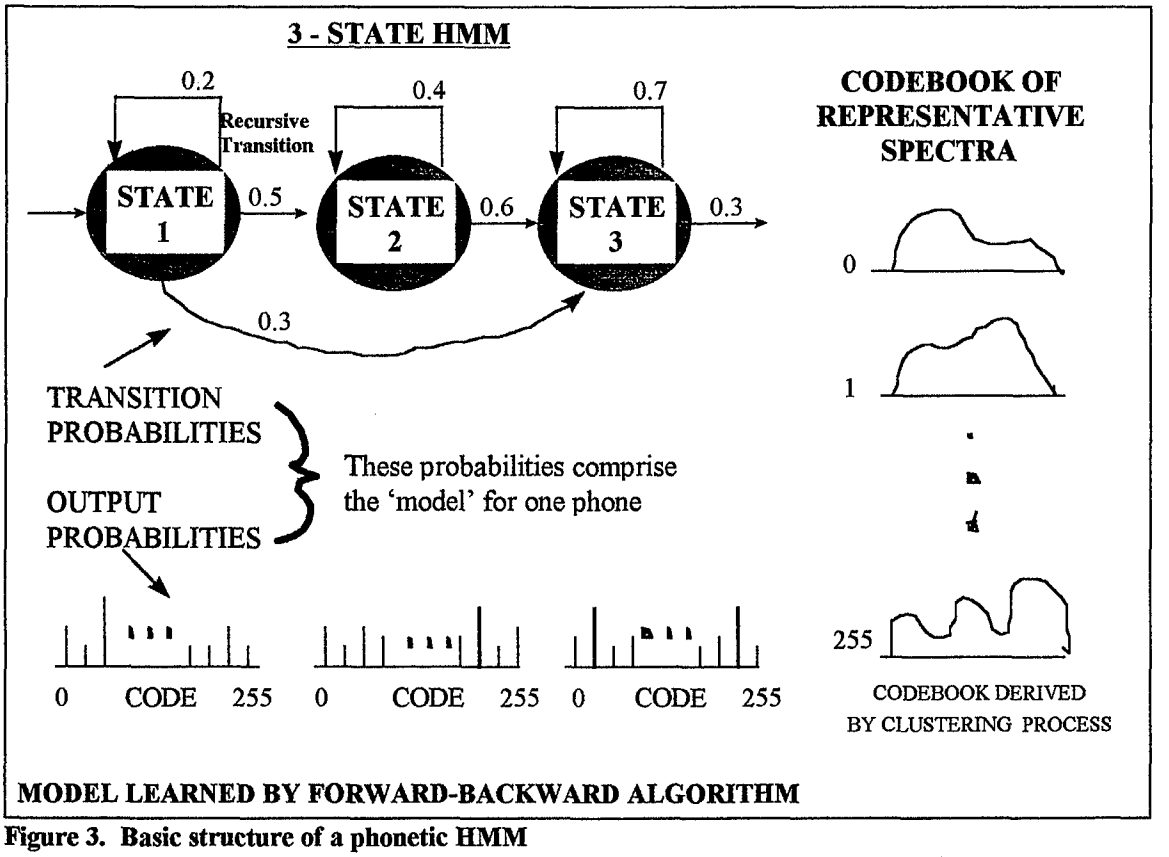

Figure 3. Basic structure of a phonetic HMM

The recognition system proceeds through the input, comparing it with stored models. If the user were to say "*Erik*" differently, the system might select the HMM

shown in Figure 3 as one of the stored models with which to compare with the user's input. If the user prolonged the *"Er"* at the start of her/his input word, it is likely that when the recognizer compared the input with the HMM in Figure 3 there would be at least one recursive transition for the first state of the HMM.

These comparisons produce a probability score indicating the likelihood that a particular stored HMM reference model is the *best match* for the input. This approach is called the *Baum-Welch maximum-likelihood algorithm*. Another common method used for stochastic recognition is the *Viterbi algorithm*. The *Viterbi algorithm* looks through a network of nodes for a sequence of HMM states that corresponds most closely to the input. This is called the *best path*. [Ref. 9: p. 41-61]

3. Types of Speech Recognition Systems

There are many types of speech recognition systems. The type of speech recognition implemented largely determines a system's capabilities. The current market consists of systems with large or small vocabularies, capable of handling speaker dependent, command and control, speaker independent, and discrete speech input. In addition, continuous speech input and natural speech input are available for restricted vocabularies (i.e., command & control or spreadsheet systems).

a. Large Vocabulary Systems

Large dictation systems have a very large active vocabulary that the voice input engine can recognize. These systems usually also have an on-line dictionary. Active vocabulary and on-line dictionary are explained later in this document. A large dictation

system has 20,000 words or more. These systems are typically used for entering large amounts of text.

b. Small Vocabulary System (Command and Control)

Command and control systems do not have large active vocabularies. Command and control systems are used for issuing commands that control devices. For example, a command and control system could be used to turn on your television or take control of your video tape recorder. You could not use a command and control system to enter large amounts of text into your application. However, you can use a large dictation system as a command and control system. The size of the active vocabulary for a command and control system is usually under 1,000 words.

c. Discrete Speech Input Systems

Discrete speech systems require a very brief pause between every utterance. An utterance could be a word or phrase. For example, if you say "print" and you pause briefly and say "document," the speech recognition system would insert those two utterances into your application. If you say "print document," the system would hear that as a command. That's how the speech recognition engines recognize words and commands.

d. Continuous Speech Input Systems

Currently, the only true continuous speech input system on the market is the Dragon System's *NaturallySpeaking* product. This product was released in June 1997 to the general public. [Ref. 10: 7/97] NaturallySpeaking Personal Edition was the first

program to recognize continuous speech with words run together, the way most people talk, as opposed to previous packages that required pauses between each word. Prior to the release of Dragon System's *NaturallySpeaking*, it was not technically possible to have a large dictation, continuous speech recognizer suited for everyone's everyday use. This technology allows users to speak to the computer naturally—without pausing between words. However, there were some companies who had VR systems that had a continuous number generator. The continuous number generator permitted users to input data into the system without a brief pause after each number.

e. Speaker Independent Systems

A speaker independent system is one that requires no or very little training. After you install the system, you can typically expect 90% accuracy right out of the box with no training. These systems are generally large dictation and command and control systems. An example of a speaker independent system would be the Kurzweil VoicePlus for Windows. [Ref. 11: 5/97]

f. Speaker Dependent Systems

A speaker dependent system requires users to participate in extensive training. Once you have trained the system, the system's recognition capability (i.e. accuracy) depends on the user's voice profile established during the training exercise. An example of a speaker dependent system is PowerSecretary, a product of Articulate Systems Incorporated. [Ref. 12: 5/97]

B. FORMS OF SPEECH RECOGNITION

One of the goals of speech recognition is to interact with computers in a speaker-independent continuous fashion. This ultimate form of speech recognition, *Natural Speech,* would allow users to talk to their computers in no specific manner and have the computer understand what the user wants, and perform these commands. This unfortunately is not yet available.

1. Speaker Dependent Vs. Speaker Independent

Speaker dependent technology requires users to participate in training exercises that may take users anywhere from 40 minutes to several hours. Once training is complete, the computer makes several calculations using the data generated during the training exercises. After these calculations, the computer generates a voice profile and uses this profile to match users' voice synthesizations. In this system, the recognizer understands a single user best because the templates are modified according to that user's speech representations. On the other hand, speaker independent technology does not need users to conduct training exercises. After installing software, users can use the speech recognition program. In this system, the templates are designed to recognize any voice and are programmed using hundreds, or thousands of speakers. [Ref. 8: 109]

2. Discrete Vs. Continuous

Discrete speech input requires users to pause between words so the computer can distinguish the word's beginning and end. Although the speech has to be modified slightly, hence slowing regular dictation, users can achieve well over 80 words per minute

(WPM), the speed of an advanced typist. Some have even reported speeds of up to 125 WPM. On the other hand, continuous speech input lets users speak in natural fluid sentences. This technology is only available for large (30,000 or higher), small vocabulary (2000 words), and limited number recognition. Small vocabularies only allow users to say the words which the system can recognize. Additionally, small vocabulary users are limited to the expandability of the libraries. [Ref. 13: 1/97] This technology is currently not useful for dictation, but is very useful for specific functions or programs, i.e., data entry systems.

C. LEADING SPEECH RECOGNITION COMPANIES

In 1994, the worldwide revenue for speech-recognition products was U.S. $347 millions. [Ref. 14: 12/04/96] The commercial speech-recognition products include dictation, automated alternate-billing service for collect or third-party billing calls, automated directory assistance for residential and business listings, and so on. Among all currently available dictation products, the three leading systems are Dragon Systems, IBM Solution and Kurzweil Applied Intelligence. Detailed information about each company can be found on the Internet at the following sites: http://www.dragonsys.com, http://www.software.ibmsolutions.com and http://www.kurzweil.com respectively.

The basic operations of these three dictation products are divided into two modes: dictation mode, containing no commands; and command mode, containing only commands. Therefore, the system has no trouble telling whether "Delete the file" is a command to be executed or a phrase which the user wants to dictate. Usually, the most common command input methods are either keyboard commands or key words. The

former will break the "pure voice input" model and is not "hands-free." The latter, on the other hand, lets users rely entirely on speech. However, if users are careless and choose a word which is used in regular conversation, the computer could mistake the users' keyword commands for dictation words.

1. Dragon Systems

Dragon Systems Inc. has one continuous version, *NaturallySpeaking* Personal Edition (see previous section) and three discrete versions of DragonDictate: the Classic Edition for Windows 2.5 (which we tested), Personal Edition (with a vocabulary of 10,000 words), and Power Edition (with a vocabulary of 60,000 words). The Classic Edition includes a vocabulary of 30,000 words with 120,000 words as backup on the CD-ROM installation. The Voicebar menu is DragonDictate's central location to gain access to commands and features. The microphone gauge reacts to sound when the microphone is on.

DragonDictate runs on Windows 3.1, 3.11, Windows 95 and Windows NT. Optional modules include vocabularies for medicine, law, journalism, business and finance, and tools for customizing applications. Voice commands can be used to control applications, such as Microsoft Corp.'s Office 95; Corel Corp.'s PerfectOffice; Novell Inc.'s GroupWise 4.1, InfoCentral, and Envoy 1.0; and Lotus Development Corp.'s SmartSuite 3, Approach 3.0, and Organizer.

2. IBM

At a press conference in New York in June 1997, IBM announced the unveiling of their continuous speech dictation version, *ViaVoice*, expected to be available by

September 1997. IBM's discrete version, *VoiceType Simply Speaking* for Windows 95, is available as a stand-alone product; the forthcoming OS/2 Warp 4.0 also offers a version of VoiceType. In the stand-alone product, VoiceCenter is the control menu for issuing commands to navigate other programs. IBM uses the VoicePad word processor for dictation. VoiceType can also use Microsoft Word in Windows 95. The standard vocabulary includes 22,000 words. Optional vocabularies are available in Legal, Emergency Medicine, Radiology, and Journalism versions.

3. Kurzweil Applied Intelligence Inc.

Kurzweil Applied Intelligence Inc.'s Kurzweil Voice for Windows, Release 2.0, is the only product that allows the user to choose the vocabulary size - 30,000 or 60,000 words. This lets the users start with a smaller vocabulary to gain experience and add words later. Kurzweil Voice comes with an earpiece (in two sizes) that attaches to the Telex Nomad microphone. Voice runs on Windows 3.1x, Windows 95 and Windows NT. Voice supports the most products compared to its competitors. Supported products include: suites (and individual spreadsheets, word processors, and databases) from Microsoft, Lotus, and Corel; e-mail packages (Microsoft Mail, Lotus cc:Mail, Lotus Notes, and Novell's GroupWise and Envoy); personal information managers (Schedule+, Organizer, InfoCentral); Intuit Inc.'s Quicken financial software; and presentations and forms generators.

D. SUMMARY

Ideally, VR permits an entirely "hands-free" operation, meaning the users don't touch the keyboard or the mouse. For example, the user can tell a computer to check electronic mail, dictate a message, and then have the computer mail the message. He / She could also navigate the World Wide Web or do research by directing a computer to look for all instances of "Woodrow Wilson" and "The League of Nations" in an electronic encyclopedia or online reference. [Ref. 16: p. 38]

The reason we haven't conversed with computers until recently is that the technology and computing power haven't been available to support it. With increasing computer horsepower and more sophisticated software, ASR is becoming a viable tool. The computer's ability to recognize and understand voice commands will be a major step forward. In fact, many experts equate true ASR as a breakthrough technology that will revolutionize the world in the same way as the printing press and typewriter.

III. VOICE RECOGNITION APPLICATIONS FOR JOINT VISION 2010

Joint Vision 2010 (JV 2010) is the conceptual template for America's Armed Forces to channel the vitality and innovation of our people and leverage technological opportunities to achieve new levels of joint warfighting effectiveness. [Ref. 17: 4/13/97] JV 2010 addresses the expected continuities and changes in the strategic environment, including technology trends and their implications for our Armed Forces. It recognizes the crucial importance of our high quality, highly trained forces and provides the basis for their enhancement by prescribing how we will fight in the early 21st century.

A thorough discussion of voice technology trends and needs would be beyond the scope of this chapter; hence, the focus here is to describe voice applications that are leading America's Armed Forces towards the vision articulated by Chairman of the Joint Chiefs of Staff. The underlying premise here is that both the performance of algorithms and the capability to implement them in real time, off-the-shelf or compact hardware, has advanced greatly beyond what was tested in prior prototype applications.

With respect to technological needs, military applications often place higher demands on robustness noise to acoustic noise and user stress than do civilian applications. [Ref. 18: pp. 1626-1641] But military applications can often be carried out in constrained task domains, where, for example, the vocabulary and grammar for speech recognition can be limited.

A. ARMY APPLICATIONS

Army contacts pointed out many applications of VR technology; three will be highlighted here: *(i)* Command and Control on the Move (C2OTM); *(ii)* the Soldier's Computer; and *(iii)* voice control of radios and other auxiliary systems in Army helicopters. In fact, the Army expects applications for voice-activated user interfaces to pervade its engineering development programs. [Ref. 19: 2/93]

In Desert Storm, the allied troops moved farther and faster than troops in any other war in history. Extraordinary efforts were needed for command and control resources to keep pace with the troops. C2OTM is an Army program aimed at ensuring the mobility of command and control for potential future needs. Figure 4 illustrates some of the mobile force elements requiring C2OTM, and some of the potential applications for speech-based systems. Typing is often a very poor input medium for mobile users, whose eyes and hands are busy with pressing tasks.

Referring to Figure 4, a foot soldier acting as a forward observer could use speech recognition to enter a stylized report that would be transmitted to command and control headquarters over a very low-rate, jam-resistant channel. Repair and maintenance in the field can be facilitated by voice access to repair information and helmet-mounted displays to show the information. In a mobile command and control vehicle, commanders need convenient access to battlefield information and a convenient means for entering and updating plans. Integrated multi-modal input/output (voice, text, pen, pointing, graphics) will help meet these requirements. Other applications suggested in Figure 4 include simple voice translation (i.e., forward observer reports), access to battlefield situation information, and weapons system selection.

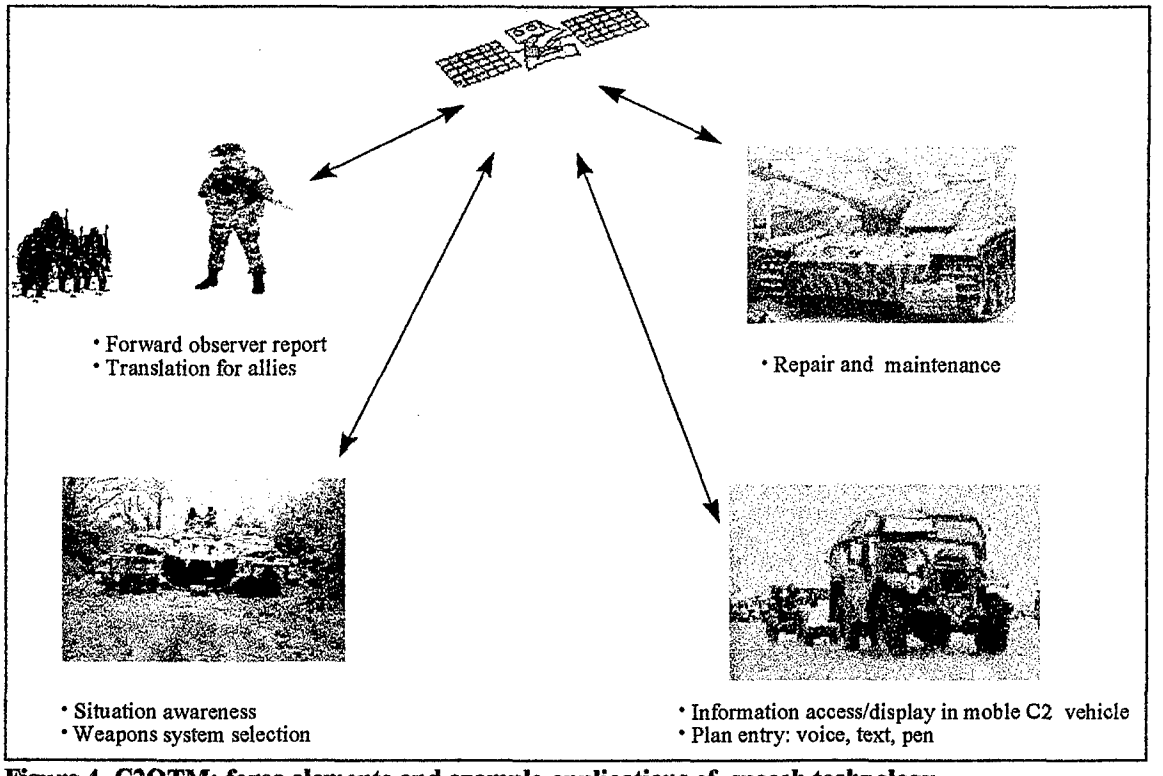

Figure 4. C2OTM: force elements and example applications of speech technology

The Soldier's Computer is an Army Communications and Electronics Command program. It responds to the information needs of the modern soldier. The overall system concept is shown in Figure 5. Voice will be a crucial input mode, since carrying and using a keyboard would be very inconvenient for the foot soldier. Functions of the Soldier's Computer are similar to those mentioned above for C2OTM. Technical issues include robust speech recognition in noisy environments and smooth integration of the various input/output modes. The technologies for both the Soldier's Computer and C2OTM have many dual-use, peacetime applications, both for everyday use and in crises such as fires or earthquakes.

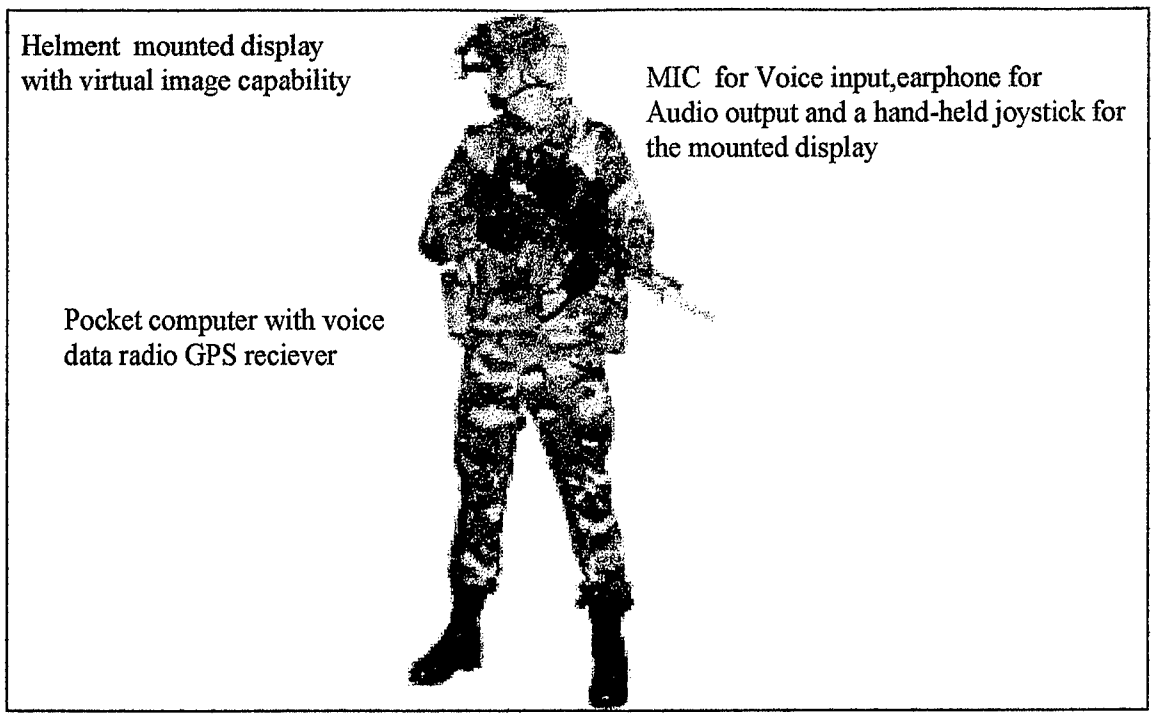

Figure 5. The Soldier's Computer: functions would be assisted by speech technology

Speech recognition for controlling radios and other devices in Army helicopters has been addressed in test and evaluation programs by the Army Avionics Research and Development Activity (AVRADA). It has been studied by groups in the United Kingdom and France. Feasibility has been demonstrated, but operational use has not been established. AVRADA has described a tragic helicopter collision in which both pilots were tuning radios, which may have been the major cause of the crash. Although voice control was a viable solution, it was not a requirement (and therefore not implemented). The Army felt that speaker-independent recognition was necessary and was not yet sufficiently robust. However, state of the art speaker-independent recognition, particularly for small vocabularies, has advanced a great deal. It is now capable of meeting the needs for controlling radios and similar equipment in a military helicopter.

B. NAVY APPLICATIONS

The Navy has a wide range of important applications of speech technology, with support from very high organizational levels. Applications outlined here will include (*i*) aircraft carrier flight deck control and information management, (*ii*) SONAR supervisor command and control , and (*iii*) combat team tactical training.

The carrier flight deck control application provides speech recognition for updates to aircraft launch, recovery weapons status, and maintenance information. At the request of Vice-Admiral Jerry O. Tuttle (Director of Operations for Space and Electronic Warfare), the Naval Research and Development Organization (NRDO) began developing a demonstration system on board the USS Ranger. Recognition requirements included open microphone; robust, noise-resistant recognition with out-of-vocabulary word rejections; and easy integration into the PC-based onboard system. An extremely successful laboratory demonstration, using a commercially available recognizer, was performed at NRDO for Admiral Tuttle in November 1991. Subsequent tests on board the USS Ranger in February 1992 identified a number of problems and needed enhancements in the overall VR (human-machine) interface systems. Correcting these problems seemed to be well within the current state of the art.

The SONAR supervisor on board a surface ship needs to control displays, direct resources, and send messages while moving about the command center and looking at command and control displays. This situation created an opportunity to apply human-machine voice communication. The Naval Underwater Systems Center developed a system demonstrating voice activation of command and control displays at a land-based integrated test site in New London, Connecticut. The system would be used first to train

SONAR supervisors at the test site and later for shipboard applications. Initial tests with supervisors from SONAR were promising, but the supervisors were dissatisfied at having to train the speaker-dependent recognizer.

The approach of first developing and using a human-machine voice communication system in a training application, and then extending it to an operational application, is a very important general theme. The training application is both useful in itself and provides essential data for developing a successful operational application (including, for example, language models and speech data characterizing the human-machine interaction.

C. AIR FORCE APPLICATIONS

The Air Force continues its long-term interest in speech input/output for the cockpit and has proposed including human-machine voice communication in the future Multi-Role Fighter. However, its is likely that the kinds of applications that were tested in the AFTI F-16 Program, with promising results but not complete success, would be much more successful with today's robust speech recognition technology. Voice control of radio frequencies, displays, and gauges could have significant effects on mission effectiveness and safety. A somewhat more advanced but technically feasible application uses VR to enter reconnaissance reports. Such a system is currently under development at the Defense Research Agency in the United Kingdom. [Ref. 20: pp. 69-72] Other Air Force applications include human-machine voice communication in airborne command posts, similar to Army and Navy command and control applications. In particular, entering data and logging information by voice could potentially reduce workloads significantly in a large variety of Command and Control Center operations.

D. HEALTHCARE APPLICATIONS

1. Hospital Applications

Medical record keeping has improved significantly over the past few decades. First, diagnosis and prescriptions were scribbled on a blank sheet of paper. Then medical records and patient notes were dictated and transcribed on IBM Electric typewriters. In the 1980's, typewriter ribbons and white out gave way to computers. Now Voice Activated Software is taking over. As of April 1997, there are more than 10,000 physicians using computerized VR to transcribe their medical reports on a daily basis. [Ref. 21: 4/18/97] However, there are probably an equal number of physicians who have purchased VR software, often at very substantial monetary and time costs, who are no longer using it. Physicians usually stop using the software because they lack internal hardware/software support from their Information Systems departments and are dissatisfied with having to learn the VR software.

In the 1990's, voice activated software, a.k.a. speech recognition, emerged as the vanguard in word processing technology. The early pioneers in this field were poorly received for several reasons. First, the hardware on the market was not yet up to the task. For instance, Kurzweil A.I. introduced VoiceRAD when 386 processors were standard operating equipment; they were insufficient to drive the software. The result was a barely functional system which generated negative word-of-mouth reviews about VR. Further, when face to face with the technology, the physician was often mystified as to why he or she was unable to produce reports with the ease and skill demonstrated by the salesperson. The answer is that the salesperson worked from a specific script. The nature of the

product is that both the speed and recognition capability of VR software improve with use or "training." In medicine, of course, a bewildering variety of pathology is "reported" or dictated on the VR system. The physician generally doesn't repeat the same words in report after report. As a result, the physician needs to use 'discrete speech,' whereby one must pause, as much as 1/5th second, between words. You - had - to - speak - like - this.

In 1994, with the advent of the Pentium Processor and the lower cost of memory (RAM or Random Access Memory now costs around $40 per megabyte) the hardware was sufficient to drive VR software. And even better, a system that cost $35,000 in 1993 was priced at $15,000 in 1994, hardware included. Voice software systems became technological breakthroughs that would even pay for themselves because they cost less than the annual salary of a typical transcriptionist. The ease of installing the necessary sound card (the voice hardware) was improving. The sophistication of the database, the speed and quality of the recognition capability and the lower hardware cost all meant it was beginning to make sense to consider VR for certain offices. However, there is a difference between 'beginning to make sense' and actually being appropriate for the average office. In 1994 the field of VR was far away from actually being cost effective for all but the most unusual medical facility.

In 1997, IBM touted the first real-time medical, continuous-speech-recognition technology (SRT) using the continuous natural language *free flow approach*, but this product is not ready for your desktop yet--unless you are a radiologist dictating a report. The key to IBM's MedSpeak/Radiology for Windows NT is that it combines continuous *free flow approach* SRT with a large vocabulary. Unlike discreet speech systems, MedSpeak/ Radiology allows users to talk at a normal pace. MedSpeak/Radiology has a

smaller vocabulary than the other packages (25,000 rather than up to 120,000 words), and it demands a more sophisticated hardware setup (a 200MHz Pentium Pro vs. a 90MHz Pentium). Doctors who have tested MedSpeak/Radiology say that it is not perfect. However, it represents a "spectacular breakthrough" after 10 years of disappointment with other SRTs. [Ref. 22: pp.1-3]

2. Medical Combat Applications

During combat, documenting medical treatment information is critical for maintaining continuity of patient care. However, knowledge of the prior status and treatment of patients is limited to the information noted on a paper Field Medical Card (FMC). MEDTAG, an electronic hand-held field medical documentation device, is designed to write and store an individual's medical data to a smart card (the Multi-technology Automated Reader Card (MARC)) as shown in Figure 6.

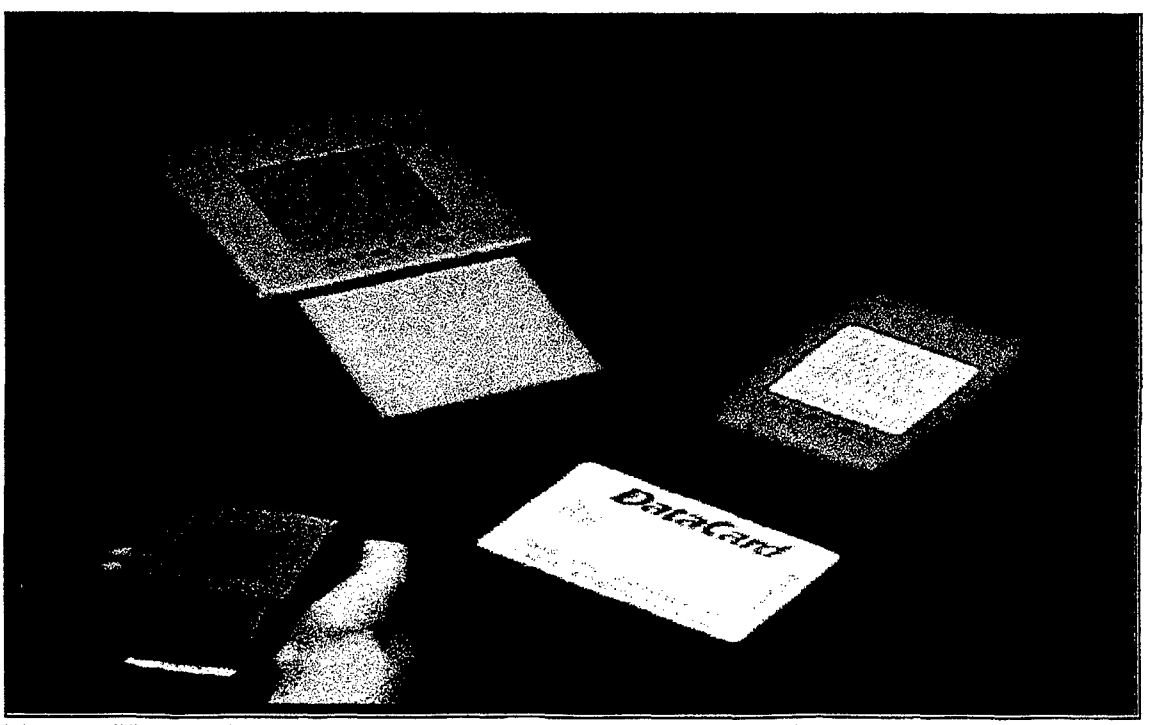

Figure 6. MEDTAG picture provided by the Naval Health Resource Center

The MEDTAG's two-button data entry method has been shown to document information more quickly than the paper FMC. Recently, considerable interest in voice data entry methods has been shown. This interest is motivated by the need to gather information quickly and accurately in an environment where the corpsman or medic's eyes and hands are busy delivering medical care. It is hoped that this "multitasking" will maximize the time available for clinical care.

The Naval Health Research Center conducted a study to evaluate the speed and accuracy of three data entry methods for documenting casualty care into the MEDTAG device (keyboard, two-button, and voice). [Ref. 23: pp. 1-16] In addition, the study gathered perception data from corpsmen regarding the ease of learning and using these input methods. Results showed that the MEDTAG two-button entry method for documenting casualty care was the fastest, followed by keyboard and the voice data entry methods, respectively. The two-button method was 8 percent faster than voice data entry. Fewer content errors were made using the speech recognition compared with the keyboard and the two-button method, but the differences were not significant. Significantly fewer scrolling errors were made using the voice method. Corpsmen reported that keyboard and speech were easiest to learn and to use for inputting data. In addition, corpsmen chose the two-button method most frequently when asked which method they preferred, which one would work best in combat, and which one would most improve field medical care. Furthermore, they chose the voice input method most frequently when asked which method allowed them to freely use their hands and interfered least with their duties.

In general, the speech recognition method was slower, yet somewhat more accurate than either the keyboard or the two-button method. In addition, users preferred the two-button method. These results must be interpreted with the understanding that the subjects were novices in using voice input, but were very experienced with keyboard input. The novelty of speech recognition could account for these findings. Viewed in this light, voice holds much promise as an input mode for medical documentation.

F. SUMMARY

There is now a great opportunity for military applications of human-machine voice communication, which will have a real impact on both users and on technology development. This opportunity results from both technical advances and very high user interest; which has increased significantly just within the past few years.

Technologists should select and push applications with a range of technical challenges, so that meaningful results can be demonstrated soon, while researchers continue to address the harder problems. In addition, it is essential that technologists work with the users to narrow the gap between the user and the state of the art. Too often, users have tested speech recognition systems that are off the shelf but well behind the state of the art and end up often discouraged by the results.

While the technology for recognizing natural speech is advancing rapidly, a huge gap still exists between human speech recognized by the human ear and speech recognized by a computer. Nevertheless, speech recognition technology has reached a level where, if applications are chosen appropriately, it can provide a means for communication between

humans and computers. Although not error-free, voice communication is approaching acceptable ranges.

IV. THE VOICE RECOGNITION PILOT PROJECT

A. PROJECT OVERVIEW

1. Problem Statement

In the Family Medical Center, at the United States Naval Hospital Roosevelt Roads (NHRR), located about 40 miles East of San Juan in Ceiba, Puerto Rico, clinicians are investigating alternatives for transcribing outpatient medical encounters in Ambulatory Clinics. This investigation started as a result of a comment raised by a physician representing the Family Practice Clinic at a Command Captains Call in September 1995. The comment was, "that more patients could be seen if the Command expanded transcription services to the Ambulatory Clinical setting." As a result, the Commanding Officer directed that a working group called the Clinical Transcription Working Group (CTWG) be established to investigate this concept. The CTWG was a multi-disciplinary team made up of nurses, physicians, healthcare administrators and medical transcriptionists. The CTWG determined that it would cost the command too much money to hire additional medical transcriptionists and expand the transcription system, when PCs were already in place on every clinician's desktop.

In January 1996, the CTWG recommended that VR be evaluated to determine its viability as an input device to an Electronic Medical Record to allow clinicians to transcribe outpatient medical encounters directly into their PCs. The CTWG felt that this alternative would eliminate the need to expand transcription services to Ambulatory Clinics, minimize costs and provide those clinicians who don't like to type with an

alternative for interfacing with their PCs. In addition, some members of the CTWG thought that implementing VR would provide each clinician with greater capabilities (i.e. navigating through current Navy standard systems like CHCS).

2. Project Objective

As a result of the CTWG findings, NHRR developed a VR pilot project that exploits the benefits of clinical automation. The goal of this project is to exploit Navy Medical Standard systems by adding VR capabilities to create a "Near Paperless Facility." This initiative coincides with the Navy Surgeon General's vision, "Move Data, Not Patients." The main purpose of the project is to determine if VR technology decreases the amount of time a clinician spends documenting clinical encounters. A decrease in documentation time could increase the time clinicians spend providing patient education and patient care; in other words, improve time management and increase productivity. The clinicians who participated in developing data instruments, testing the NHRRs VR pilot project and evaluating research findings are listed in Appendix A.

B. NHRR VOICE RECOGNITION SYSTEM OVERVIEW

1. DragonDictate Voice Recognition Application

The software implemented in the pilot project was the DragonDictate Classic Edition Version 2.0. This software was selected because it was the simplest to use, did not require any specific hardware components and it had been evaluated in previous research performed at the Naval Postgraduate School. [Ref. 24: pp. 47-48] Version 2.52 is the latest version offered (available since March 1997). DragonDictate is a combined

navigator/dictation software package. The Classic Edition uses a 30 thousand word standard vocabulary. DragonMed, a 30 thousand word Language Module for Health Care Professionals, was combined with the Classic Version to ensure that standard medical terminology was available. The software came with a DragonDictate VXI headset microphone. The entire program requires 36 megabytes of hard disk space and 16 megabytes of RAM. Additional systems requirements for the software are found in the users guide included with the software. [Ref. 25, pp. 2-3]

2. Voice Recognition Hardware Configuration

The hardware configuration for the participating clinicians includes the following: a 486/66 MHz or Pentium 100 MHz processor; a SoundBlaster 16 sound card; 24 megabytes of Random Access Memory (RAM); and a color monitor. This configuration was selected because DragonDictate software is compatible with a 486/66 MHz or Pentium processor and requires a minimum of 12 megabytes of RAM (however, 16 megabytes is recommended).

To ensure interoperability with the Department of Defense Health Affairs Military Health Services System architecture, the Bureau of Medicine and Surgery Open Architecture (MED-OA) / Composite Healthcare System (CHCS) architecture was used to integrate DragonDictate into the clinician desktop. The NHRR clinician's desktop automation project provided each clinician access to CHCS, E-mail, Windows NT, CD-ROM towers and the World Wide Web through their desktop PC and MED-OA network.

A Windows NT Advanced Server was used. This allowed clinicians electronic access to patient records from any desktop connected to the network. Only authorized

users had access to these files. The Windows NT operating system was designated as the Navy's standard in March 1997, as it provides the most advanced password protection system available, providing the required partitioning and restricting access to medical record information. [Ref. 26: pp. 1-3]

A Write Once, Read Many (WORM) drive was added to the Windows NT Server for archiving which was performed on a quarterly basis. Archiving provided a permanent, unchangeable record of patient data at that specific point in time. Clinicians were allowed to make new entries to patients' electronic record while previous entries were protected.

3. Voice Recognition Electronic Medical Record

Windows for Workgroups (WFW) 3.11 is the standard operating environment on each participating clinician's PC. The networking capability within the WFW 3.11 software allows users to access shared drives on PCs and central file servers via MED-OA.

Microsoft (MS) Office software has been in place at NHRR for the past year and a half as the standard office automation software. An Electronic Medical Record (EMR) was created by Dr. Riggins utilizing MS Word to evaluate the VR concept for transcribing medical encounters. EMR was created using a standard template file patterned after the Standard Form 600 currently used in outpatient medical records. A brief description of the EMR follows:

Patients name and demographic data are entered on page one. Also, printed in the footer is the date anytime a hard copy is printed, document file name, patient's allergies (linked to the problem summary list), and the patient's age. Page two of the EMR

contains a table of contents which allows the clinicians to easily perform chart reviews and to navigate within the record; Page three is the patient's Summary of Care and contains a list of chronic medical problems and prescribed medications.

A chronological record of outpatient visits follows with bookmark entries (available as a MS Word function) allowing for rapid insertion of subsequent notes. Lab and Radiology sections are included. Clinicians are able to cut and paste both Lab and Radiology results directly from CHCS into the patients electronic record. The radiologist and clinician can setup a process for results to be directly dictated into the patients electronic chart. "Canned" text can easily be created using the MS Word autotext capability allowing each provider to extend their list of standard entries. A detailed description of the EMR is provided in the users manual in Appendix B.

V. VOICE RECOGNITION PILOT PROJECT FINDINGS

This chapter presents the findings from six different data instruments used to evaluate the viability, perception and performance of the VR pilot project over a nine month period, mid-August 1996 to April 1997. Section A covers the data instruments, collection procedures and findings. Section B covers the benefits and costs associated with implementing a transcription system at NHRR.

A. DATA INSTRUMENTS, COLLECTION PROCEDURES AND FINDINGS

1. Perception Questionnaire

a. Instrument Development

A perception questionnaire was developed to assess the Navy's Medical Departments perception of VR technology. The data gathered from this questionnaire addresses the following research question: What is the perception of VR technology within the Navy's Medical Department? The perception questionnaire was patterned after the Department of Research/Department of Family Medicine, Medical University of South Carolina patient perspective survey. [Ref. 27, pp. 606-610] Each numbered question is an item and henceforth will be referred to by item number. The item types are ordinal scales and require that the respondent mark one or more answers as specified by the directions. An example of the perception questionnaire is provided in Appendix C.

b. Collection Procedures

The questionnaire was distributed during the NHRR's VR pilot project demonstration at the Surgeon General Leadership Conference in Washington DC on August 23, 1996. Attendees were asked to fill out the questionnaires after they saw the pilot project presented by Dr. Riggins and LT Green, listed Appendix A. They were told that the questionnaire was collecting data on the perception of VR technology for thesis research at the Naval Postgraduate School, Monterey, California.

c. Findings

Distributing the questionnaire to the entire Navy medical community was impossible due to the resources required and time constraints. Therefore, these findings are based on the small sample size that was available during the 1996 Surgeon Generals Leadership Conference; the corresponding statistical significance should be interpreted correspondingly.

A total of 74 questionnaires were distributed to attendees who saw the VR pilot project presentation. A total of 25 of the 74 questionnaires were returned. Twenty-two were entered into the data base constructed for the analysis. Three surveys were rejected because they were not sufficiently completed. The valid response rate was approximately 30% of the entire population. Table 1 provides a breakdown of the findings for each item number in the questionnaire.

These respondents were senior Medical Officers, Lieutenant Commander or above, including of 10 Physicians (45%), 4 Nurses (18%), 7 Healthcare Administrators (32%) and 1 Medical Information System Officer (5%). During this analysis, particular

	Total	Percentage
1. Please indicate your primary function:		
1. Physician	10	45%
2. Physician Assistant	0	0%
3. Nurse	4	18%
4. Healthcare Administrator	7	32%
5. Management Information Systems Officer	1	5%
6. other (Describe)	0	0%
2. Were you familiar with voice recognition technology before this demonstration?		
1. Yes	16	73%
2. No	6	27%
3. Have you previously used voice recognition software?		
1. Never	18	82%
2. 1 - 5 times prior to now	4	18%
3. More than 5 times prior to now	0	0%
4. Did the voice recognition technology appear to be easy to use, as it was demonstrated to you today?		
1. Yes	21	95%
2. No	1	5%
5. In the demonstration, the voice recognition software's performance was:		
1. Excellent	10	45%
2. Good	12	55%
3. Poor	0	0%
4. No Comment	0	0%
6. Give your impression of the microphone headset's appearance.		
1. Awkward	4	17%
2. Natural	4	17%
3. Easy to wear	10	43%
4. Distracting	3	13%
5. Uncomfortable	1	4%
6. Other	0	0%
7. As you see it, what are the benefits of voice recognition as a computer interface in the clinical arena? (check as many as necessary)		
1. Cost and time savings	16	25%
2. Improved thoroughness and legibility of SOAP notes	21	33%
3. Reduce repetitive keyboard and mouse motions	16	25%
4. Increase time spent on preventive maintenance and patient education	11	17%
5. No benefit	0	0%
6. Other	0	0%
8. As you see it, what are drawbacks of voice recognition as a computer interface in the clinical arena? (check as many as necessary)		
1. Staff training	7	21%
2. Equipment requirements	6	18%
3. Willingness to use	13	39%
4. No drawbacks	4	12%
5. Other	3	9%
9. Regarding your impression of the voice recognition technology, would you say that:		
1. The voice recognition interface would shorten the length of the patient encounter and save the user a considerable amount of time.	9	41%
2. The voice recognition interface would slightly shorten the length of the patient encounter and save the user a small amount of time.	7	32%
3. The voice recognition interface would neither shorten or lengthen the patient encounter and the user work place would stay the same.	2	9%
4. The voice recognition interface would extend the length of the patient encounter and require slightly more user time.	4	18%
5. The voice recognition interface would considerably lengthened patient encounter and require much more user time.	0	0%
10. In your opinion, what are the primary drawbacks to the voice recognition system? (check as many as necessary)		
1. Microphone headset	5	16%
2. Recognition errors	12	39%
3. Dictating notes in front of patient	4	13%
4. Initial voice training	4	13%
5. None	3	10%
6. Other	3	10%
11. Rate your overall impression of voice recognition as a computer interface:		
1. Positive	22	100%
2. Neutral	0	0%
3. Negative	0	0%

Table 1. Findings from VR Perception Questionnaire

attention was given to the physicians responses, as physicians would use a system like the VR pilot project.

The majority of the respondents, 16 (73%), were familiar with VR technology before seeing this presentation. Only 7 (44%) of the 16 respondents familiar with the VR technology were physicians. Eighteen (82%) of the respondents had never used VR software, but 21 (95%) of the respondents said *yes* when asked if VR technology appeared easy to use, as it was presented. Eight out of the 10 physicians who thought it looked easy had never used the VR technology before.

Ten (45%) of the respondents felt that VR performance was excellent in the presentation and the remaining respondents felt that it was good (Item 5). Item 6 responses showed that only 4 (17%) of the respondents felt that of microphone headset appeared awkward, 4 (17%) felt that the headset appeared natural, 3 (13%) felt that it was distracting, 1 (4%) felt that it was uncomfortable and the remaining respondents, 10 (43%), felt that the headset was easy to wear. Three of the physician respondents felt that the headset appeared awkward, 1 felt that the appearance was distracting, 2 felt that the appearance was natural, and the remaining four chose easy to wear.

The respondents were asked to check as many answers as necessary on Item 7; there were 64 responses. *Improved thoroughness and legibility of SOAP notes* was selected 21 times (33%) by the respondents; *Cost/time savings* and *Reduced repetitive keyboard and mouse motion* were both selected 16 times (25%); and *Increased time spent on preventive maintenance and patient education* was selected 11 times (17%). *Improved thoroughness and legibility of SOAP notes* was the number one selection of the 10 physicians responding to Item 7.

The respondents were asked to check as many answers as necessary on Item 8; there were 34 responses. *Willingness to use* was selected 13 times (39%) by the respondents; *Staff training* was selected 7 times (21%); *Equipment requirements* was selected 6 times(18%); *No drawbacks* was selected 4 times (12%); and *Other* was selected 4 times (12%). The answers given under the *Other's* were *speed, slow startup, accuracy* and *user friendliness*. *Willingness to use* was selected by 7 of the 10 physicians responding to Item 8.

Item 9 responses showed that 16 (73%) of the respondents felt that VR technology used as an input interface would shorten or slightly shorten the length of the patient encounter and save the user considerable time. Only 4 (18%) felt that the VR interface would extend the patient encounter and require slightly more user time. Six of the physician respondents felt that VR technology used as an input interface would shorten or slightly shorten the length of the patient encounter and save the user considerable time. On the other hand, only 3 physicians felt that the VR interface would extend the patient encounter and require slightly more user time.

The respondents were asked to check as many answers as necessary on Item 10. There were a total of 31 responses. The drawback selected by the most respondents, 12 (39%), was *Recognition errors*. *Microphone headset* was selected 5 times (16%). *Dictating notes in front of the patient* and *Initial voice training* were both selected 4 times (13%). *No drawbacks* and *Other* were selected 3 times (10%). The explanation listed under *Other* were *recognition speed, system speed,* and *speed*. The physician's selected *Microphone headset* and *Recognition errors* as the primary

drawbacks of the VR pilot system. Both were selected 4 times. Physicians selected *Initial voice training* 3 times.

The respondents were asked to rate their overall impression of VR as a computer interface in Item 11. All respondents, 22 (100%), had a positive impression of VR as a computer interface. In addition, the responders noted the following comments: 1) Interesting; 2) Tremendous potential in several areas including Radiology, Pathology & Ambulatory care clinics; 3) In some cases, dictation can not be done in front of patient; 4) An asset for many already and will be for more soon; 5) I'm impressed and see tremendous application and use; and 6) Needs to be integrated into CHCS. Should be tested at other Navy Medical facilities.

2. Patient Satisfaction Questionnaire

a. Instrument Development

The patient satisfaction questionnaire was developed to measure patient reactions to various components of the clinician-patient relationship. The data gathered from the questionnaire addresses the impact on patient satisfaction when clinicians use computer technology during clinical encounters. In addition, the questionnaire addressed the impact that computer technology has on the clinician providing the patient preventive maintenance and/or education.

The questionnaire was patterned after the Service Evaluation Questionnaire (SEQ) and the Family Practice Clinic Questionnaire (FPCQ). The SEQ was used because it was developed specifically to measure patient satisfaction in healthcare. [Ref. 28: pp. 299-314] The FPCQ was recently used to measure satisfaction in a family practice

setting. [Ref. 29: pp. 217-222] An example of the patient satisfaction questionnaire is provided in Appendix D. Each numbered question is an item and henceforth will be referred to by item number. The questionnaire used a five-point Likert scale to assess each item number. The five-point scale assumes an equal interval continuum across the items answers, from 1 (very low/strongly disagree) to 5 (very high/strongly agree). The 3rd digit of the scale represents a neutral or moderate position. This scaling technique is simple, easily manipulated, powerful and best suited to applications where attitudinal or issue position measurements are required.

b. Collection Procedures

The questionnaire was distributed to study subjects (patients) in the Family Medical Center at NHRR from December 1996 to February 1997. The patients were all adults (18 years of age or older). The questionnaires were distributed to three different patient groups: **Group A:** SOAP Notes were transcribed manually in front of the patient during the clinical encounter. **Group B:** SOAP Notes were transcribed using the keyboard and EMR in front of the patient during clinical the encounter. **Group C:** SOAP Notes were transcribed using VR and EMR in front of the patient during the clinical encounter.

The patients were randomly asked to participate in the study. The patients were told that the questionnaire would collect data on patient satisfaction with the clinical encounter. The details of the study were discussed with the patients after they had completed the questionnaire. This ensured that the patients' answers weren't biased against how the clinicians documented their SOAP notes (i.e. manually, keyboard or by

voice). Medical charts from patients participating in the study were randomly marked with a sticker to alert the clinician that the patient was in **Group A, B or C**. The SOAP notes were then transcribed by the clinicians accordingly.

To ensure that the clinicians were blinded to the contents and composition of the questionnaire, they did not see it until after the data was collected. To ensure compliance, a representative from the Family Medical Center kept the questionnaires secure. The representative randomly assigned subjects to groups and distributed/collected the questionnaires to/from the study subjects. After all of the questionnaires were collected, they were forwarded to the author for evaluation.

c. Findings

To assist in presenting the findings, the terms in Table 2 are used:

Mean	The arithmetic average of the data values.
Median	The middle value for a data set ordered in magnitude.
Mode	Most frequently used response in data a set.
Standard Deviation	The square root of the variance. (*Variance* is a measure of variability obtained from the sum of the squared deviations of the observations from their mean divided by n-1).

Table 2. List of statistical terms

Values assigned to each item were designed by compiling all responses from patients in a group and calculating the mean, median, mode, variance and standard deviation of the responses. If the median and mode were the same value, this number was used. If they were different, whichever value was closer to the mean was used. The variance and standard deviation are given to show the degree of diversity of responses

from the patients. Due to time constraints and lack of available patients, a total of 60 patients were randomly selected to participate in this study. A total of 20 patient were assigned to each group.

Group A consisted of 11 males (55%) and 9 females (45%). Ten (55%) of the respondents were between the ages of 18-35, 5 (25%) were between the ages of 36-55, 1 (5%) was between the ages of 55-56 and 4 (20%) were between the ages of 66-75. In addition, 1 (5%) of the respondents had less than an 8th grade education, 1 (5%) had some high school, 5 (25%) had a high school or equivalent degree, 8 (20%) had some college education and only 5 (25%) had college degrees. **Group A** clinicians did not use a computer during the patient encounter, so item numbers 17-21 did not apply to this group. The findings from item numbers 5-16 are shown in Table 3, Figure 7 and Table 4.

ITEM #	5	6	7	8	9	10	11	12	13	14	15	16	17-21
MEAN	3.4	3.1	4.0	4.5	4.3	4.3	4.3	4.4	4.5	4.1	4.2	4.4	N/A
MEDIAN	4	2.5	4	5	4.5	5	5	5	5	5	5	5	N/A
MODE	4	5	4	5	5	5	5	5	5	5	5	5	N/A
STD DEV	1.5	1.7	0.8	0.8	0.9	1.2	1.1	1.2	0.8	1.3	1.2	1.0	N/A

Table 3. *Group A* patient satisfaction statistical findings

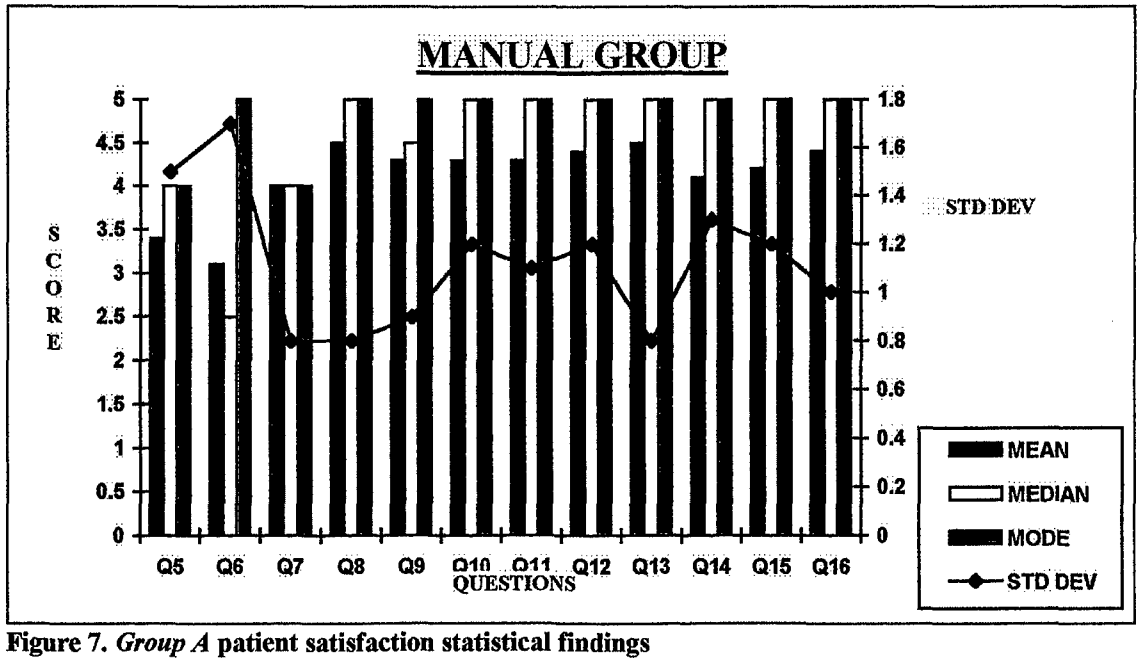

Figure 7. *Group A* patient satisfaction statistical findings

5. How familiar are you with the capabilities and/or limitations of computers?				
Not Familiar	Barely	Somewhat	Familiar	Very Familiar
5	0	3	7	5
25%	0%	15%	35%	25%
6. How often do you use a computer at work or at home?				
Never	Once per month	Once a week	Every other day	Everyday
5	5	0	2	7
25%	25%	0%	10%	35%
7. Did the clinician give you as much information concerning the treatment, illness and preventive maintenance as you would have liked?				
No Information	Less than expected	Average amount	More than I expected	Extremely more than
0	1	5	9	5
0%	5%	25%	45%	25%
8. How interested was the clinician in helping you?				
Very Uninterested	Uninterested	Somewhat Interested	Interested	Very Interested
0	0	2	6	12
0%	0%	10%	30%	60%
9. The clinician was competent and knowledgeable during visit.				
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
0	3	0	8	9
0%	15%	0%	40%	45%
10. I had time to ask all the questions that I wanted to ask today.				
1	2	0	4	13
5%	10%	0%	20%	65%
11. The clinician spent as much time with me as I would have liked.				
0	3	0	5	12
0%	15%	0%	25%	60%
12. The clinician listened to what I had to say during my appointment.				
1	2	0	3	14
5%	10%	0%	15%	70%
13. The clinician was responsive to my concerns.				
0	1	1	6	12
0%	5%	5%	30%	60%
14. I understood the clinician's explanation of my problem.				
1	3	0	4	12
5%	15%	0%	20%	60%
15. The length of time it took to be seen was reasonable.				
0	4	0	5	11
0%	20%	0%	25%	55%
16. Overall, I am satisfied with the clinician I met with today.				
2	1	0	5	12
10%	5%	0%	25%	60%
17. My medical records privacy would not be compromise by storing them on the computer.				
N/A	N/A	N/A	N/A	N/A
18. I felt comfortable with the clinician wearing a headset during my office visit.				
N/A	N/A	N/A	N/A	N/A
19. Recording of the exam notes using a microphone helps me to better understand the problem.				
N/A	N/A	N/A	N/A	N/A
20. What extent did the use of the computer enable your clinician to spend more time addressing your problems and concerns?				
Strong Negative Affect	Negative	Neutral	Positive	Strong Positive Affect
N/A	N/A	N/A	N/A	N/A
21. What extent did your clinician's use of the computer affect his/her attention to your problems or concerns?				
N/A	N/A	N/A	N/A	N/A

Table 4. *Group A* patient satisfaction findings

Group B consisted of 7 males (35%) and 13 females (65%). Thirteen (65%) of the respondents were between the ages of 18-35, 3 (15%) were between the ages of 36-55, 3 (15%) were between the ages of 55-56 and only 1 (5%) was between the ages of 66-75. In addition, 4 (20%) of the respondents had a high school or equivalent degree, 11 (55%) had some college education and 5 (25%) had college degrees. **Group B** clinicians did not use voice recognition technology during the patient encounters, so item numbers 18-19 did not apply to this group. The findings from item numbers 5-17 and 20-21 are shown in Table 5, Figure 8 and Table 6.

ITEM #	5	6	7	8-9	10	11	12-13	14	15	16	17	18-19	20	21
MEAN	3.8	3.3	3.8	4.7	4.8	4.6	4.6	4.6	4.5	4.8	4.2	N/A	3.9	3.7
MEDIAN	4	4	4	5	5	5	5	5	5	5	4.5	N/A	4	4
MODE	3	5	3	5	5	5	5	5	5	5	5	N/A	4	3
STDDEV	1.1	1.8	0.8	0.6	0.6	0.8	0.6	0.7	0.7	0.4	1.1	N/A	0.9	1.1

Table 5. ***Group B*** **patient satisfaction statistical findings**

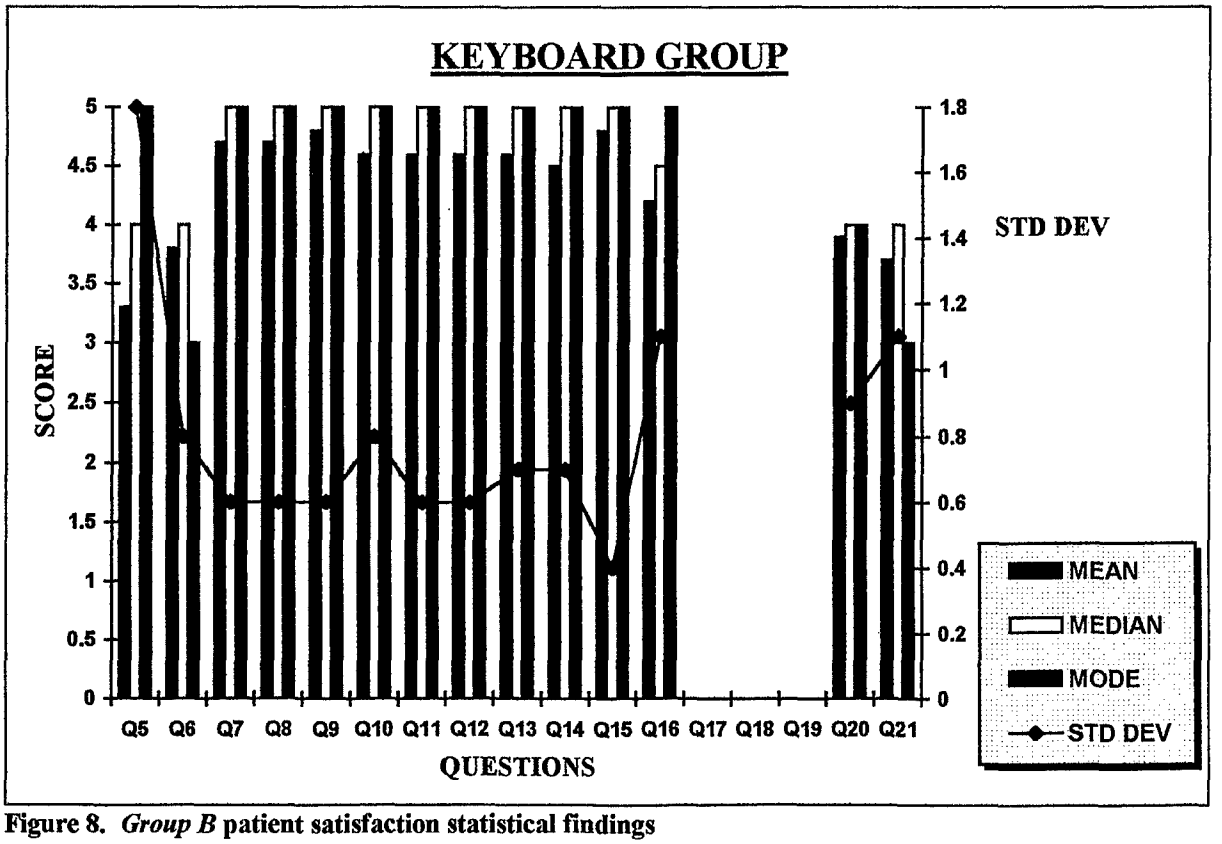

Figure 8. ***Group B*** **patient satisfaction statistical findings**

5. How familiar are you with the capabilities and/or limitations of computers?				
Not Familiar	Barely	Somewhat	Familiar	Very Familiar
1	1	6	6	6
5%	5%	30%	30%	30%
6. How often do you use a computer at work or at home?				
Never	Once per month	Once a week	Every other day	Everyday
5	4		2	9
25%	20%	0%	10%	45%
7. Did the clinician give you as much information concerning the treatment, illness and preventive maintenance as you would have liked?				
No Information	Less than expected	Average amount	More than I expected	Extremely more than
0	0	7	9	4
0%	0%	35%	45%	20%
8. How interested was the clinician in helping you?				
Very Uninterested	Uninterested	Somewhat Interested	Interested	Very Interested
0	0	1	5	14
0%	0%	5%	25%	70%
9. The clinician was competent and knowledgeable during visit.				
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
0	2	0	4	14
0%	10%	0%	20%	70%
10. I had time to ask all the questions that I wanted to ask today.				
0	1	0	3	16
0%	5%	0%	15%	80%
11. The clinician spent as much time with me as I would have liked.				
0	3	0	3	14
0%	15%	0%	15%	70%
12. The clinician listened to what I had to say during my appointment.				
0	1	0	6	13
0%	5%	0%	30%	65%
13. The clinician was responsive to my concerns.				
0	1	0	6	13
0%	5%	0%	30%	65%
14. I understood the clinician's explanation of my problem.				
0	2	0	4	14
0%	10%	0%	20%	70%
15. The length of time it took to be seen was reasonable.				
0	2	0	6	12
0%	10%	0%	30%	60%
16. Overall, I am satisfied with the clinician I met with today.				
0	0	0	5	15
0%	0%	0%	25%	75%
17. My medical records privacy would not be compromise by storing them on the computer.				
1	1	2	6	10
5%	5%	10%	30%	50%
18. I felt comfortable with the clinician wearing a headset during my office visit.				
N/A	N/A	N/A	N/A	N/A
19. Recording of the exam notes using a microphone helps me to better understand the problem.				
N/A	N/A	N/A	N/A	N/A
20. What extent did the use of the computer enable your clinician to spend more time addressing your problems and concerns?				
Strong Negative Affect	Negative	Neutral	Positive	Strong Positive Affect
0	1	5	8	6
0%	5%	25%	40%	30%
21. What extent did your clinician's use of the computer affect his/her attention to your problems or concerns?				
1	1	7	5	6
5%	5%	35%	25%	30%

Table 6. *Group B* patient satisfaction findings

Group C consisted of 7 males (35%) and 13 females (65%). Thirteen (65%) of the respondents were between the ages of 18-35, and 7 (35%) were between the ages of 36-55. In addition, 2 (10%) of the respondents had some high school, 8 (40%) had a high school or equivalent degree, 6 (30%) had some college education and 4 (20%) had college degrees. The findings from item numbers 5-21 are shown in Table 7, Figure 9 and Table 8.

ITEM #	5	6	7	8	9	10-13	14-15	16	17	18	19	20	21
MEAN	4.1	3.9	4.2	4.7	4.6	4.6	4.6	4.6	3.9	4.4	3.9	3.7	3.7
MEDIAN	4	5	4	5	5	5	5	5	4	5	4	4	5
MODE	5	5	4	5	5	5	5	5	5	5	5	5	5
STD DEV	0.9	1.5	0.7	0.9	1.1	1.2	1.1	1.2	1.2	1.1	1.2	1.4	1.6

Table 7. ***Group C*** **patient satisfaction statistical findings**

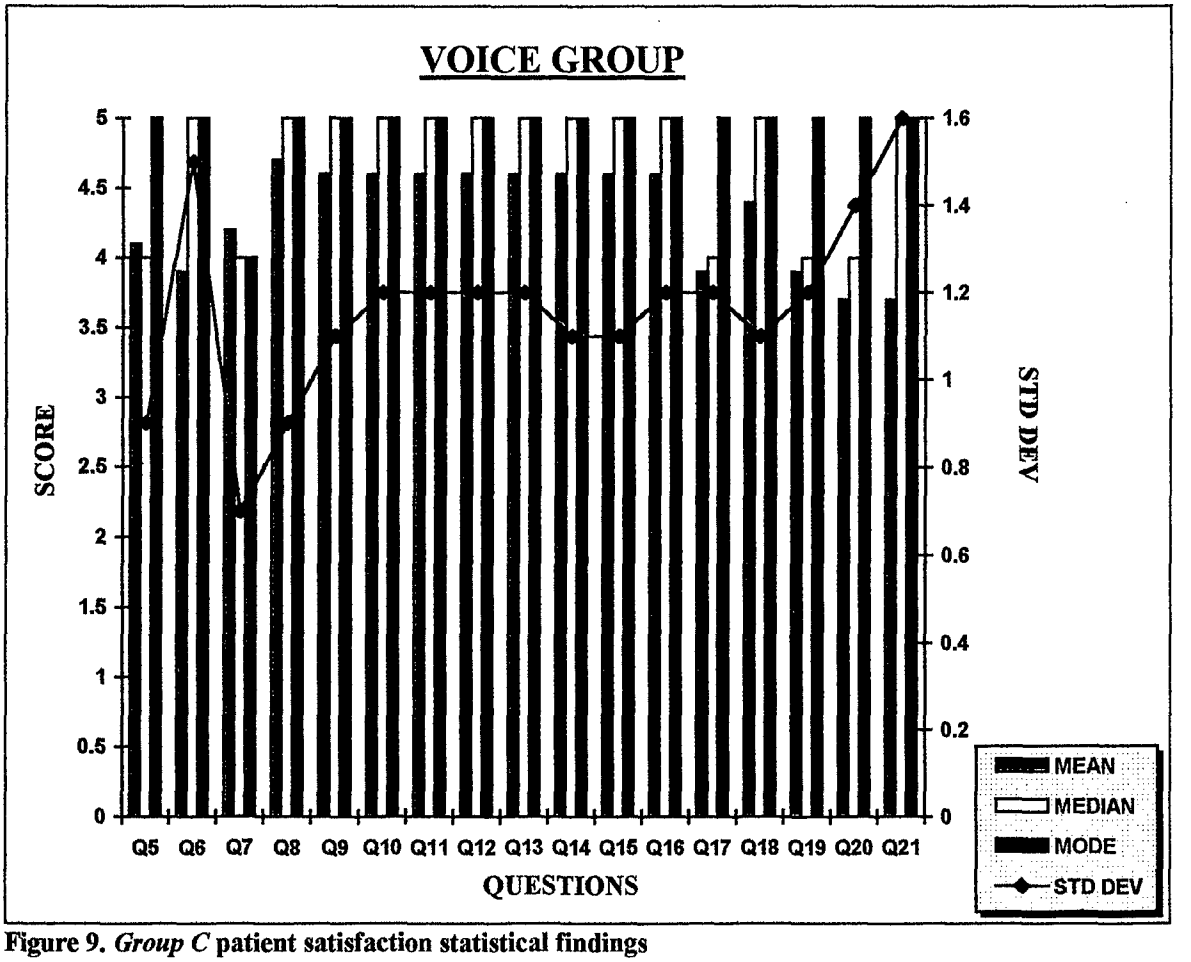

Figure 9. ***Group C*** **patient satisfaction statistical findings**

5. How familiar are you with the capabilities and/or limitations of computers?				
Not Familiar	Barely	Somewhat	Familiar	Very Familiar
0	1	5	6	8
0%	5%	25%	30%	40%
6. How often do you use a computer at work or at home?				
Never	Once per month	Once a week	Every other day	Everyday
3	1	2	4	10
15%	5%	10%	20%	50%
7. Did the clinician give you as much information concerning the treatment, illness and preventive maintenance as you would have liked?				
No Information	Less than expected	Average amount	More than I expected	Extremely more than
0	0	3	11	6
0%	0%	15%	55%	30%
8. How interested was the clinician in helping you?				
Very Uninterested	Uninterested	Somewhat Interested	Interested	Very Interested
1	0	0	3	16
5%	0%	0%	15%	80%
9. The clinician was competent and knowledgeable during visit.				
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	1	0	1	17
5%	5%	0%	5%	85%
10. I had time to ask all the questions that I wanted to ask today.				
2	0	0	1	17
10%	0%	0%	5%	85%
11. The clinician spent as much time with me as I would have liked.				
2	0	0	1	17
10%	0%	0%	5%	85%
12. The clinician listened to what I had to say during my appointment.				
2	0	0	1	17
10%	0%	0%	5%	85%
13. The clinician was responsive to my concerns.				
2	0	0	1	17
10%	0%	0%	5%	85%
14. I understood the clinician's explanation of my problem.				
1	1	0	1	17
5%	5%	0%	5%	85%
15. The length of time it took to be seen was reasonable.				
1	1	0	1	17
5%	5%	0%	5%	85%
16. Overall, I am satisfied with the clinician I met with today.				
2	0	0	0	18
10%	0%	0%	0%	90%
17. My medical records privacy would not be compromise by storing them on the computer.				
1	2	4	6	7
5%	10%	20%	30%	35%
18. I felt comfortable with the clinician wearing a headset during my office visit.				
1	1	0	6	12
5%	5%	0%	30%	60%
19. Recording of the exam notes using a microphone helps me to better understand the problem.				
1	2	5	2	8
5%	10%	25%	20%	40%
20. What extent did the use of the computer enable your clinician to spend more time addressing your problems and concerns?				
Strong Negative Affect	Negative	Neutral	Positive	Strong Positive Affect
3	2	5	2	8
15%	10%	25%	10%	40%
21. What extent did your clinician's use of the computer affect his/her attention to your problems or concerns?				
4	3	1	3	9
20%	15%	5%	15%	45%

Table 8. *Group C* patient satisfaction findings

Group A had a higher percentage of males than **Groups B** or **Group C**. There was no differences between **Group B** and **Group C** with regards to sex. **Group B** and **Group C** had a higher percentage of respondents in the 18-35 age group.

The findings across all groups indicated that 75% of **Group A**, 90% of **Group B** and 95% of **Group C** were *"somewhat familiar"* to *"very familiar"* with the capabilities and/or limitations of computers. In regards to frequency of computer use, 25% of **Group A** and **Group B** *never* used computers while only 3% of **Group C** *never* used a computer.

Eighty-five percent of **Group C** responded that the clinicians provided *"more than"* to *"extremely more than"* expected information concerning the treatment, illness and preventive maintenance. The frequency of this response in **Group A** and **Group B** was 70% and 65%, respectively.

In response to the statement "I am satisfied with the clinician I met with today," 100% of **Group B** responded *"agree to strongly agree;"* The frequency of this response in **Group A** and **Group C** was 85% and 90%, respectively. Ten percent of **Group A** and **Group C** responded "strongly disagree" to the above statement.

Eighty percent of **Group B** and 65% of **Group C** responded *"agree* to *strongly agree"* to the statement "My medical records privacy would not being compromised by storing them on a computer." Ten percent of **Group B** and 15% of **Group C** responded *"strongly disagree* to *disagree"* to the above statement.

Seventy percent of **Group B** and 50% of **Group C** responded *"positive* to *strong positive affect"* to the question "What extent did the use of the computer enable your clinician to spend more time addressing your problems and concerns?" Five percent

of **Group B** and 25% of **Group C** responded *"strong negative affect* to *negative"* to the above question, 25% from both groups responded *"neutral."*

Fifty-five percent of **Group B** and 60% of **Group C** responded *"positive* to *strong positive affect"* in regards to the question "What extent did your clinician's use of the computer affect his/her attention to your problems and concerns?" Ten percent of **Group B** and 35% of **Group C** responded *"strong negative affect* to *negative"* to the above question, 35% of **Group B** and 5% of **Group C** responded *"neutral."*

Participants in **Group C** were asked to respond to the following statement "I felt comfortable with the clinician wearing a headset during my office visit." Ninety percent responded *"agree* to *strongly agree;"* 10 % responded *"strongly disagree* to *disagree."* In addition, Group C participants were asked to respond to the statement, "Recording of the exam notes using a microphone helps me to better understand the problem." Sixty percent responded *"agree* to *strongly agree,"* 15 % responded *"strongly disagree* to *disagree,"* and 25% responded *"neutral."*

Participants in all three groups were asked to document the length of their office visit. The findings are shown in Table 9 and Figure 10. The average visit for **Group C** lasted 24.5 minutes. **Group A** and **Group B** visits lasted 25 and 27.3 minutes respectively.

	Group A Minutes (Manual)	**Group B Minutes (Keyboard)**	**Group C Minutes (Voice)**
MEAN	25	27.3	24.5
MEDIAN	30	20	20
MODE	30	20	20
STD DEV	8.6	16.2	12.3

Table 9. Groups length of visit per minute table

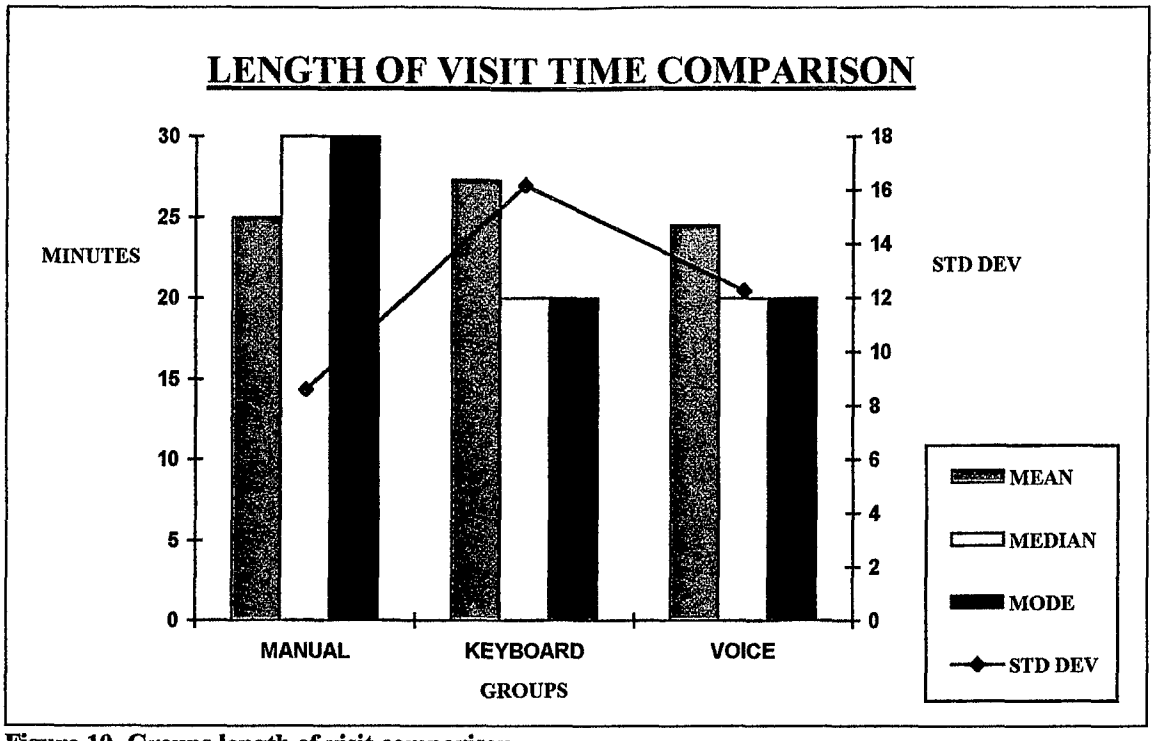

Figure 10. Groups length of visit comparison

3. Implementation Interview Questionnaire

a. Instrument Development

An implementation questionnaire was developed to collect NHRR's feedback on the VR technology implementation. To ensure the experience was positive, affirmative inquiry questions were used along with basic questions about people's jobs and tasks. The interview questionnaire was patterned after the Nadler's Feedback and Organization Development instruments [Ref. 30, pp. 186-191] and the Appreciative Inquiry for Constructing Provocative Propositions instruments [Ref. 31: 9/96]; both provided general guidelines to set up interviews.

b. Collection Procedures

The interviews were conducted in March 1997, after completing the VR Pilot project evaluation. Five people were interviewed. The interviewees included the three clinicians directly involved in the study, the Chief Information Officer (CIO), and the immediate supervisor in the Family Medical Center at NHRR. The interview questionnaire and interviewee responses are provided in Appendix E.

c. Findings

Responses varied, but each interviewee willingly gave his/her time and thoughts. The interviewees indicated that the implementation was very successful, mainly because they had support for the project at all levels within the chain of command. In addition, the Commanding Officer was very interested in the project because he felt that "VR would maximize the potential of the clinician's workstation, enhancing productivity and ultimately patient care." Almost all interviewees responded most positively to the affirmative inquiry questions, and all of them were surprised to be asked about themselves. They expected to be asked only about VR pilot project. The following presents some excerpts from the interviews which help to show the many positive aspects of the VR pilot project implementation:

Richard Riggins, NHRR's Family Practice Physician:

> It is a way for me to document my clinical encounter. The VR program requires dedicated support if you're going to implement it command wide. I don't see us implementing this command wide with our current Management Information System staff because they are over worked. There have been a lot of little bugs with the hardware and software that you find in any project like this. If you had one or two people dedicated to support the program (mainly hardware) everyday, then you would see a rapid return on your investment.

I saw it as a tool to transcribe notes rather than write them. The VR fits with my job, there are some limitations, but I have been able to effectively apply it using a word processor. It is a very effective tool for me and not a great hindrance in the clinic. Also, I use it for SOAP notes, Email, navigating through CHCS, ordering X-rays and Labs, PowerPoint presentation and memorandums.

Just using your voice to interface with the computer is the ultimate natural way to interface things, moving that way is a step in the right direction. Keyboard is a throw back to the past, and I think it's designed to slow us down. It is not built for efficiency. I think if we continue to look at more and better ways to interface with the computers, we will get more out of the PCs. Discrete speech is usable in some cases, VR will be an excellent tool when continuous speech becomes available.

The benefits of using it here is using it with an EMR, you manage patients' records by voice, and using VR speeds up the process. Also, the tremendous improvements in interfacing with CHCS through a Windows based emulation program was an unexpected benefit of the VR.

The system is very user dependent but this is by far the better way to document the encounter notes than scribbling in the record. Although, sometimes writing (not speaking out loud) is better when you need to note something that is sensitive and don't want a passersby to inadvertently hear. Voice is a good way, but not the only way. I see voice as a hybrid system in the future along with keyboard, mouse and probably a pen based system.

Michael Green, NHRR's Chief Information Officer:

Voice recognition was a the next step in taking the clinicians desktop and maximizing its capability. We put a PC on each clinicians desk, at first all they were doing was interfacing through the PC to the CHCS. It was just a replacement for the dumb terminal. Then as clinicians were given software, they were able to do word processing, e-mail, spreadsheets and other task that could not be done with a dumb terminal. We felt that the best interface to the electronic medical record was voice recognition because clinicians do not like to type. Through a combination of keyboard, mouse and voice they became very proficient with the PC and that makes it that much easier to use.

VR provides much easier and better interface for the clinician after training for two or three weeks. As clinicians use it, voice becomes that much more powerful, where they start thinking out loud what they want to do. For instance, to log on to CHCS requires several keystrokes and using

a mouse, they say one word and CHCS comes up. Before it took two or three commands to get there, now it only takes one voice activated command. Voice is much quicker than hand, keyboard coordination.

The future PCs in information systems is voice activation/voice recognition. It's moving that way. If you look at the systems that are put out by many of the vendors, they already include a sound card with voice capture capability and microphones. They see it as the future and they are trying to sell us systems with that capability.

Melody McMath, NHRR's Physician Assistant:

I use it for everything; charting, writing instructions and memorandums, anything I have to type. The thing that would help me do my job better with VR is greater speed. When commercial VR programs are more developed and distributed specifically to do health records, it will be a lot faster. This VR project is very good, but it could be so much better if it was tied into some sort of database, where I could pull up all the patients that were only my patients.

There wasn't any formal training. The VR Program itself is pretty self explanatory. You go through the tutorial/training for twenty-thirty minutes and the system learns your voice as you use it.

Dictating was initially slower than writing, even now it's sometimes slow, because of changes in the environment, but it is definitely more thorough. My handwritten notes don't say as much as my voice dictated ones.

Another benefit is reduced manpower time because we don't have to send corpsmen or myself to find records for follow-ups or call the previous provider to verify a particular note. If you save time you save manpower dollars. If we dictate it we can proof read it right then, save it and its ready for a next provider if a follow-up is required.

Wesly Marquand, NHRRs Family Practice Physician:

When it is running and I have time, I will sit down an dictate notes and patients charts. I think you need to have meticulous support for your electronic gear (hardware and software). As a physician you have only 15 minutes for turnaround of a patient, we don't have time to be tweaking the hardware or adjusting the software. I don't want to spend a lot of time making templates and macros at this point, mainly because I don't know how. If I knew how, it would not be a big deal. But the thing is we don't have the training in place to get you over the learning curve.

This program requires up front training and continuous on going support for VR software, local area network and the PCs. The biggest problem I had using the VR system was PC failures.

Pablo Pizaro, NHRRs Family Practice Physician:

My impression is that when you have a lot of patients waiting or an emergency comes up, VR is not a good thing to use. I have a friend out in the civilian sector that has used it. He said that it is a nice idea but it requires highly motivated people because of the computer systems they have. As of today, you have strong limitations on what you can do. You need templates and your own special language. It is not like normal speech that we do everyday.

For somethings it will work, for example procedures that you do on a regular bases (i.e. PAPS and Vasectomy notes). When you have a variety of things then you will get behind. If you use it to see the same type of patients over and over again, you build up a nice history of documented words which speeds up the process.

We need a VR system that does not require a functional highly motivated person. You need a system out of the box that has built in templates and macros and is ready to go. That way the most computer illiterate person can use it. When you have a system that is functional and working, I will use it because I am very interested in VR.

4. Clinical Encounter Narrative Scenarios

a. Instrument Development

Clinical encounter narrative scenarios were developed to collect data on the time required by a clinician to document clinical encounter (SOAP) notes and to evaluate how thorough the SOAP notes were with regard to the actual encounter narrative. For the purpose of this thesis, *thorough* is defined as the most complete, legible and accurate SOAP note that best depicts the narrative scenarios. The clinical encounter narrative scenarios were prepared by Dr. Michael Joyner (listed in Appendix A). The

scenarios were patterned after patient encounters experienced by Dr. Joyner. The five different clinical narrative scenarios used in this study are provided in Appendix F.

b. Collection Procedures

The clinical encounter narrative scenario data was collected at the end of the workday, once or twice a week, from November 1996 to March 1997. Narratives were rotated through each clinician three times to be transcribed into SOAP notes. The clinicians used a different transcription method each time during the four month study period. The three methods conducted were: 1) manually using pen and paper charts, 2) using a keyboard to transcribe notes into the EMR and 3) using VR to transcribe notes into the EMR. The NHRR CIO ensured that the narratives were secure, and that the transcription methods were distributed evenly over the collection period. To evaluate the *thoroughness* of the SOAP notes, five clinicians from Monterey, California (listed in Appendix A) were given a medical record containing nine SOAP notes created by the NHRR's clinicians using the methods above (the nine SOAP notes were grouped into three sets because they were created by 3 different clinicians). The Monterey clinicians were asked to review the records as if they were doing follow-ups and select one SOAP note from each of the sets in the record that they felt was the most *thorough* with regard to the associated narrative scenario. All of the findings are presented in the next subsection.

c. Findings

The total and average times required by the clinicians to document the SOAP notes using the *Manual*, *Keyboard* and *Voice* methods are shown in Table 10. The

Manual method took the least time for the clinicians to document the SOAP notes, followed by *Voice* and *Keyboard* respectively, as shown in Figure 11. The follow-up clinicians in Appendix A selected the Voice method 9 out of 15 times as being the most *thorough;* the *Keyboard* method was selected 6 times and the *Manual* method was never selected.

PA McMATH			
	MANUAL	KEYBOARD	VOICE
NARRATIVE I	5:39	10:59	8:45
NARRATIVE II	10:00	10:15	12:26
NARRATIVE III	3:00	5:56	7:13
NARRATIVE IV	3:25	10:26	5:36
NARRATIVE V	5:44	18:46	11:06
DR. MARQUAND			
NARRATIVE I	3:19	10:58	11:10
NARRATIVE II	4:09	9:20	15:36
NARRATIVE III	2:34	6:39	7:11
NARRATIVE IV	2:06	7:59	7:52
NARRATIVE V	3:50	10:09	8:18
DR. RIGGINS			
NARRATIVE I	4:30	6:57	7:30
NARRATIVE II	6:37	6:04	5:47
NARRATIVE III	2:19	4:52	4:25
NARRATIVE IV	3:25	4:56	5:54
NARRATIVE V	3:02	5:43	6:44
STATISTICAL ANALYSIS			
MEAN	4:14	8:39	8:22
MEDIAN	3:25	7:59	7:30
MODE	3:25	N/A	N/A
STD DEV	0.086	0.149	0.125

Table 10. Documented times and averages for clinical encounters narratives

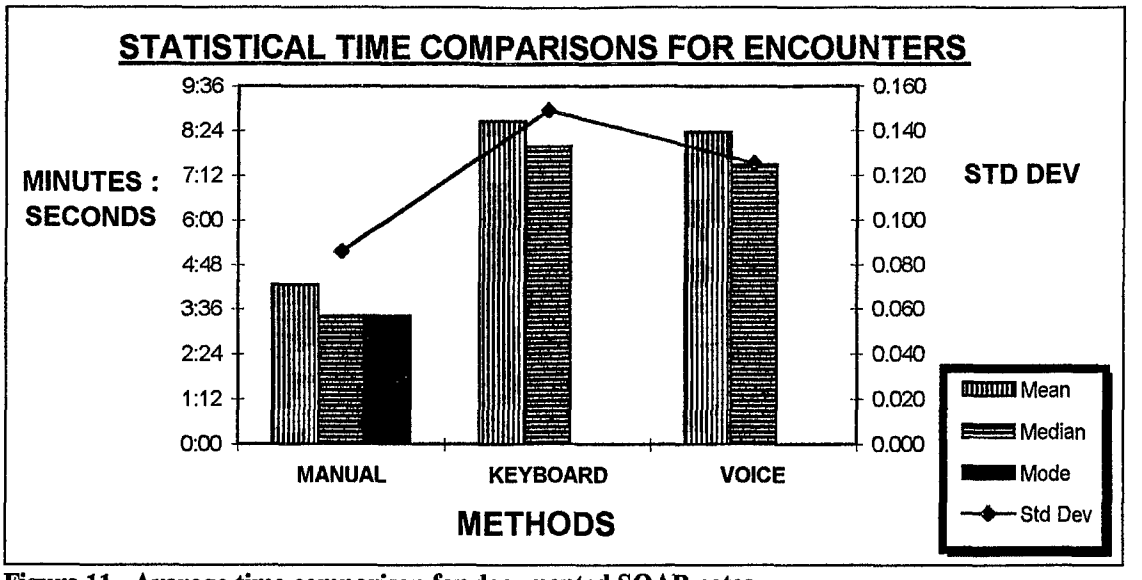

Figure 11. Average time comparison for documented SOAP notes

5. Medical Encounter Dictation Evaluation Scenarios

a. Instrument Development

Pre-written SOAP note scenarios were developed to assess and measure the dictation and learning capability of the Classic Edition of DragonDictate with the add-on Medical Language Module for Healthcare Professionals. The SOAP notes utilized in this study were patterned after medical encounters experienced by Dr. Riggins throughout his career. The SOAP notes are provided in Appendix G.

b. Collection Procedures

Dictation and learning capability data was collected by dictating five pre-written SOAP notes consisting of 912 dictation words and commands into the EMR. This collection phase was completed by creating a new user account on a IBM compatible Pentium 133 MHz PC with 48 Mb of RAM. The pre-written notes were dictated ten times in a semi-controlled environment, recording the number of mistakes and the length

of time required to complete the dictation. The mistakes were corrected as they occurred (using the technique described in the DragonDictate User's Guide [Ref. 32, pp. 32-42]). The errors were calculated as a fraction of the total number of commands, giving a percentage of each error type as well as the total number of errors. For this study, five types of mistakes were measured:

1. Type 1: The software recognizes the wrong word or command but the correct word or command is located in the choice list.

2. Type 2: The software recognizes the wrong word or command but the correct word or command is not located in the choice list.

3. Type 3: The software heard nothing even though a word or command was uttered.

4. Type 4: The software heard the correct word or command but performed the wrong action or did nothing.

5. Type 5: The software heard ambient noise and interpreted it as a word creating an error.

These measures of performance were computed against the pre-written SOAP notes in Appendix G. The results are of the measures are provided in the next subsection.

c. Findings

Table 11 and Figure 12 show that the number of errors made by DragonDictate decreased with each trial. The number of Type 2 errors decreased when those words not previously listed in the choice menu were added in the list. Eventually these words became recognized as the primary, or first selection, choices in the list. This means that they became the words that were recognized by DragonDictate as the input words uttered by the user. The other error types became less frequent also, helping improve overall software performance.

Trial	I	II	III	IV	V	VI	VII	VIII	IX	X
Type I Error	8.22	8.77	5.81	6.14	5.92	4.61	4.06	4.28	4.71	2.96
Type II Error	8.77	7.89	3.62	3.51	2.52	2.08	3.51	1.75	2.52	1.64
Type III Error	3.18	2.19	0.88	0.66	0.33	0.00	0.33	0.66	0.22	0.44
Type IV Error	3.73	3.29	0.66	0.88	2.08	0.66	1.86	0.99	0.77	0.77
Type V Error	4.06	2.39	0.88	0.44	0.44	0.44	0.44	0.55	0.66	0.22
Total Error	27.96	25.55	11.84	11.62	11.18	7.79	10.20	8.44	8.88	6.03

Table 11. Percentage of each error type

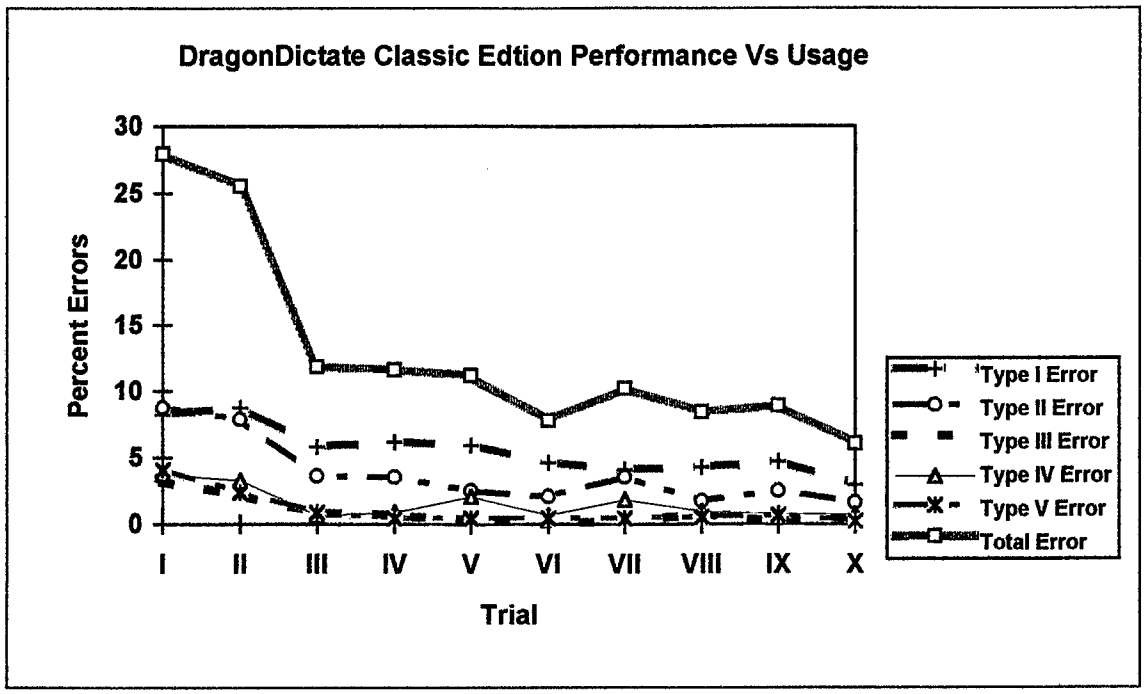

Figure 12. Number of recognition errors performed Vs. Trials

Table 12 and Figure 13 demonstrate that using DragonDictate generally improves its accuracy, words per minutes and input time (Accuracy is defined as the complement of the total percentage of errors. It is 100 - the % errors). This supports Dragon systems, Inc.'s claim that DragonDictate's overall performance improves with use. The greatest degree of accuracy reached during this evaluation was 96%. This was achieved within a semi-controlled environment where the user had some distractions, such as the neighbor's music in the background, ringing telephones, and family members walking around the room. The words per minute also increased and the amount of time required to dictate the SOAP notes decreased, as shown in Graph 7. This reflects the

improved accuracy. As accuracy improved, the user was able to increase dictation speed. Less time was required to correct errors introduced by the software. The longest input time was 125:10 (mm:ss), with an accuracy of 82% and 11 words per minutes. The fastest input time was 30:48, with an accuracy of 96% and 30 words per minutes.

	I	II	III	IV	V	VI	VII	VIII	IX	X
Accuracy (%)	82	84	91	92	92	94	93	94	93	96
Words Per Minutes	11	14	17	20	22	25	25	26	26	30
Time (Minutes)	125	87	58	48	47	38	40	35	36	30

Table 12. DragonDictate performance data over 10 trails

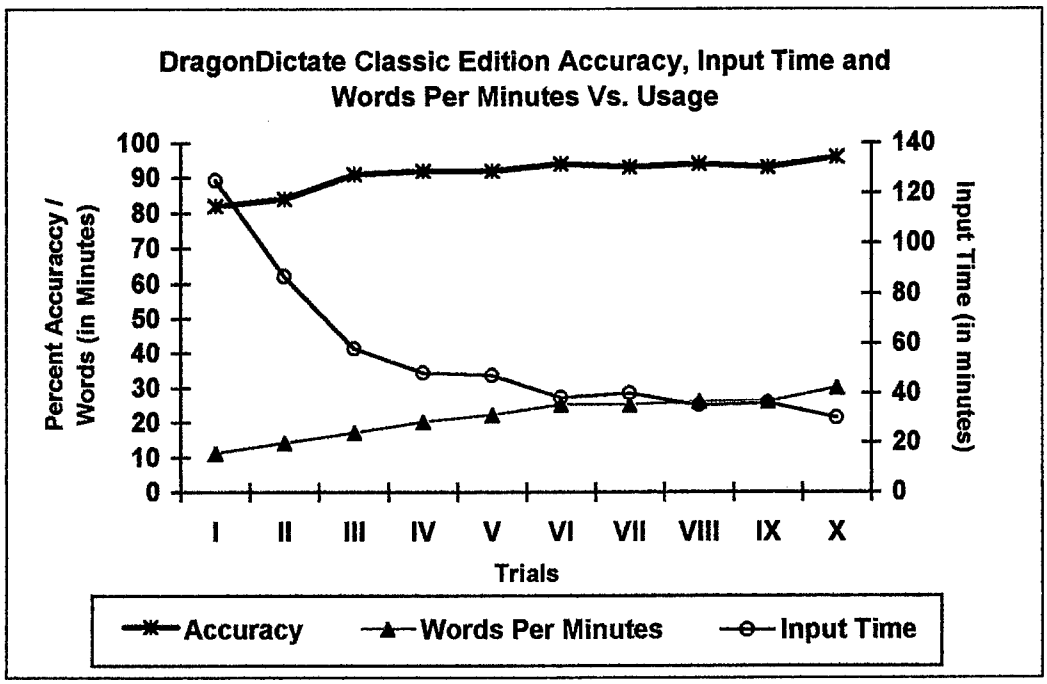

Figure 13. Accuracy Vs. Input Time Vs. Words per Minutes Vs. Trails

6. NHRR Voice Recognition Data Table

A physician participating in this study collected recognition data over a period of 51 days in an uncontrolled environment at NHRR. This data was analyzed to determined the average recognition accuracy over the 51 day collection period. In addition, average words dictated per minute, correct recognition, mis-recognition, percentage of incorrect

dictated words and number of new words added over the 51 day period were determined. The daily VR data table is provided in Appendix H. The findings are shown in Table 13 and Figure 14. The average recognition accuracy was 89%. The average words dictated per minute was 23, but this is not a true average because the physician did not pause the system every time when it was not in use. To attain an accurate words per minutes count, DragonDictate requires the user to pause the system whenever dictation is stopped or interrupted. This is because DragonDictate provides pronunciation for over 110,000 words that are common to the American English language; the user is required to add uncommon proper names, procedure names or possessive forms.

	Words per Min	Correct Recognition	% Correct	Mis-Recognition	% Incorrect	New Words
MEAN	23	972	89	118	11	2
MEDIAN	23	836	89	96	11	2
MODE	23	1774	89	59	11	1
STDEV	4.0	572.6	1.6	75.8	1.9	1.9

Table 13. Statistical data collected for 51 days by a physician at NHRR

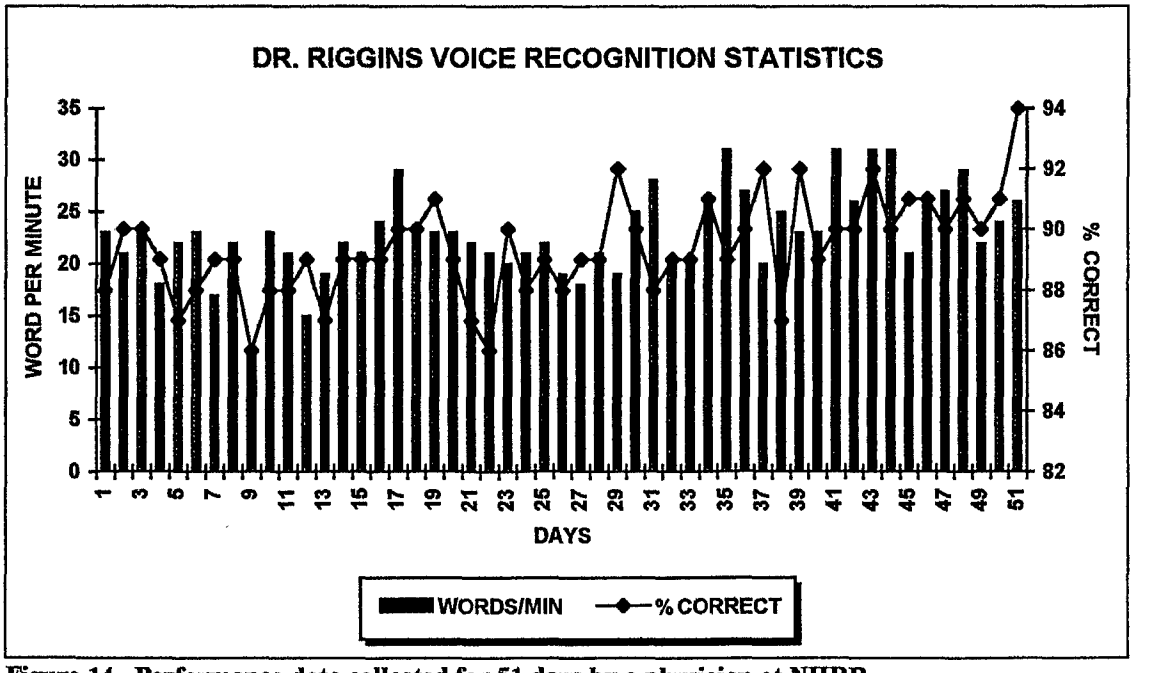

Figure 14. Performance data collected for 51 days by a physician at NHRR

B. PRELIMINARY VR COST BENEFITS ANALYSIS

A new technology must add enough benefits to justify its cost. It is only in the last few years that this has been true of voice recognition. The break-even price differs with the market segment and the application within that segment. NHRRs identified two alternatives for transcribing outpatient medical encounters in Ambulatory Clinics. *Alternative A* was to implement a VR system and *Alternative B* was to expand transcription services to the Ambulatory Clinics.

1. Alternative A - Voice Recognition Cost and Benefits

The NHRR's first year cost for *Alternative A,* per Family Medical Center (FMC) clinicians' desktop, in 1996 was approximately $1400.00. This cost included DragonDictate Classic edition (60K word dictionary), Pro Series DragonMed Professional (30K word dictionary), 32 Megabytes of Random Access Memory and a SoundBlaster Pro 16 sound board. The cost to implement VR on every FMC clinicians desktop, approximately 5, is around $7,000.00. The cost to implement VR on all 32 clinicians' desktops at NHRR would be $44,800.00. Maintenance cost for the VR systems were not included in the first years startup cost and was beyond the scope of this thesis. However, maintenance cost for the outyears is likely to be modest because of the continuous decline in VR software costs and ease of installation. Installation could be performed by either the user or MIS department personnel. The perceived benefits of *Alternative A* are as follows:

1. Reduce Graphical User Interface overload;
2. Easier-to-use macros for canned text input;

3. Easier and better interface for slow typing intermittent clinicians;

4. Increased clinicians speed transcribing SOAP notes;

5. Instant turnaround time for documenting notes in patients charts;

6. Lower or no medical transcriptionist cost;

7. No mouse movements and key strokes when navigating through Navy standard systems and other administrative application;

8. Lower manpower time required to contact previous providers to verify handwritten SOAP notes during follow-up medical encounters;

9. Increased thoroughness and readability of patient charts.

2. Alternative B - Expanded Transcription Service Costs and Benefits

The NHRR's first year cost for *Alternative B* would involve hiring at least one full-time transcriptionist at a GS-5 salary, plus benefits. In 1996, GS-5 base salary was approximately $25,000.00 per year. The Dictaphone equipment and installation costs for each clinician was approximately $1,000.00. In addition, a new transcription system (i.e. Digital Voice Server, etc.) would be required to support additional clinicians, as the old system architecture was antiquated. The new architecture would cost approximately $10,000.00. The approximated first year startup cost for *Alternative B* in the FMC would be $40,000.00. The minimum total approximated first year startup cost for *Alternative B* in all Ambulatory Clinics would be $142,000.00, which would include at least four full-time equivalent GS-5 employees. Maintenance costs for the outyears for transcription services were beyond the scope of this thesis. The perceived benefits of *Alternative B* at the NHRR are as follows:

1. Hire home-based medical transcriptionist to reduce overhead;

2. Fast turnaround time, speed and accuracy of dictated notes;

3. Flexibility to dictation preference;

4. Digital Voice System that does not require audio tapes or patient records to leave the clinician office;

5. Transcription system provides stability, proven performance and intergration capability for future Computerized Patient Records.

3. Alternative A Vs. Alternative B

Alternative A offers NHRRs clinicians greater potential benefits at reduced costs. This makes *Alternative A* a more viable solution, when compared to *Alternative B*. *Alternative A* could be implemented on every clinician's desktop at approximately the cost required to implement *Alternative B* in one department at NHRR (i.e. the FMC department). In addition, Government downsizing, budget limitations and the inability to hire additional people inhibits the NHRRs FMC department clinicians from strongly pursing *Alternative B*.

VI. CONCLUSIONS

A. SUMMARY OF FINDINGS

In this section, the findings from Chapter V and Chapter II will be used to answer the research questions proposed in this thesis.

What is VR? What are the primary advantages and disadvantages of VR? VR is generally used as a human-computer interface for other software. When it functions effectively in this role, a VR system performs three primary tasks:

- *Preprocessing* Converts the spoken input into a form the recognizer can process
- *Recognition* Identifies what has been said
- *Communication* Sends the recognized input to the appropriate software/hardware systems

Preprocessing, recognition, and communication should be invisible to VR interface users. The user sees them indirectly through the accuracy and speed of the system. Accuracy and speed are tools that users call upon to evaluate a VR interface. The primary advantages of VR in healthcare are: 1) Increased productivity in terms of the ability to get more work done with comparable or better accuracy than can be achieved using existing input methods; 2) Reduces the need for transcriptionists to transcribe data from audio tapes; 3) Speaking is the most natural and universal method of communicating; 4) Frees the hands and eyes in a Command and Control or Medical Combat environments. The primary disadvantages in healthcare are: 1) The voluminous data in the speech sound wave; 2) The paucity of information in the speech sound wave; 3) Speaking could violate

a patient's privacy; 4) Possible interference from noise, distortion or variability in the user's speech pattern.

Studies have been performed at the Naval Postgraduate School, Monterey, California and by others, that demonstrate and support the definite advantages of speech input over other currently available input forms. [Ref. 33: pp. 35-38] These include reports on the effects of stress and changing environments on the users of various recognition systems (most of these were performed by the late Gary K. Poock, formerly a professor with the Systems Management department at the Naval Postgraduate school), the effect of feedback on users of VR equipment, and the effects of various background noises on VR systems recognition capabilities.

What is the perception of VR technology within the Navy's Medical Department? One hundred percent of medical population sampled at the Surgeon Generals Leadership Conference in Washington DC on August 23, 1996 had a positive impression of VR as a computer interface. The responders perceived *Improved thoroughness and legibility of SOAP notes* as the primary benefit of VR as a computer interface in the clinical arena. *Cost / time savings* and *Reduced repetitive keyboard and mouse motion* tied as the second selection. In addition, the following comments were noted by the responders: 1) interesting technology; 2) tremendous potential in several areas including Radiology, Pathology & Ambulatory care clinics; 3) in some cases, dictation can not be done in front of patient; 4) an asset for many already and will be for more soon; 5) I'm impressed and see tremendous application and use; and 6) should be tested at other Navy Medical facilities and needs to be integrated into CHCS.

What are the hardware and software requirements for establishing a VR system? To get the maximum performance out of the current VR technology, the minimum hardware requirements are a Pentium based 133 megahertz computer, 32MB of RAM (48MB is recommended with Windows NT) and 60MB of hard disk space. There are a lot of VR products on the market today. The three leading companies are Dragon Systems Inc., IBM Solution and Kurzweil Applied Intelligence. The software requirement would depend on how the user plans to implement and use the technology.

What are the costs and benefits of implementing a VR system as an input device in the Family Medical Center at NHRRs? The implementation cost for VR on every Family Medical Center clinicians' desktop, approximately 5, would be around $7,000.00 compared to $40,000.00 to implement a transcription service. The potential benefits if VR is implement correctly are: 1) Reduce Graphical User Interface overload; 2) Easier-to-use macros for canned text input; 3) Easier and better interface for slow typing intermittent clinicians; 4) Increased clinicians speed transcribing SOAP notes; 5) Instant turnaround time for documenting notes in patients charts; 6) Lower or no medical transcriptionist cost; 7) No mouse movements and key strokes when navigating through Navy standard systems and other administrative application; 8) Lower manpower time required to contact previous providers to verify handwritten SOAP notes during follow-up medical encounters; and 9) Increased thoroughness and readability of patient charts.

What skills are necessary to implement a VR system? According to the clinicians involved in the study, the VR software was self-explanatory and easy to use. The user goes through the tutorial/training for twenty-thirty minutes and the system learns your voice as you use it. The only skill required for the VR software is the ability to speak

clearly. In addition to make dictating faster and easier, the user should become familiar with building simple dictation macros. Dictation macros are commands that can automate any kind of repeated text. The user guide that comes with the software walks you through the process step by step.

What maintenance skills will be required to maintain the VR system? What is the impact in terms of staff and equipment? Maintenance skills for the VR software are not required, the MIS department should be able to install updates without much difficulty. When implementing a VR system, the organization should ensure that the MIS department has enough staff to support the hardware. NHRR experienced a lot of little bugs, mainly with the computer hardware equipment and the Local Area Network, that affected VR software performance. For future implementations, MIS departments should assign at least one person to oversee/support the program (mainly hardware) daily, then the organization would see a rapid return on their investment.

Does VR decrease the overall time a clinician spends transcribing and documenting clinical encounters? Yes. ***Do VR transcribed SOAP notes increase the thoroughness of patient charts?*** Yes. The overall times and averages required by NHRRs clinicians to transcribe SOAP notes using the *Manual*, *Keyboard* and *Voice* methods indicated that the *Voice method* was the second fastest way to transcribe SOAP notes into a patient's record. Although, the *Manual* method was the fastest, the *Voice* method was selected 9 out of 15 times as being the most *thorough* (i.e. the most complete, legible and accurate SOAP note). The *Manual* method was never selected. Adding *thoroughness* factors decreases the overall time required for a clinician to transcribe and document the clinical encounter. In addition, VR transcribed notes decrease the time a

clinician spends reviewing and inquiring about SOAP notes transcribed by other providers during a follow-up encounter.

What is the impact on patient satisfaction when a clinician uses computer technology during clinical encounters? To what extent did the use of the computer enable the clinician to spend more time addressing patients problems and concerns? In this study, there was no significant impact on patient satisfaction associated with written as opposed to computer record-taking (keyboard or voice) by the clinicians. There was also no significant impact in patient assessment of clinicians' distraction or the quality of clinician listening. In previous studies, clinicians have used computers differently during the examinations. Some have typed throughout the visit, as others have waited until the end. One study found significant differences between clinicians' ratings, hypothesizing that the differences may have been related to how they used the computer in front of the patient. [Ref. 34: pp. 615-22] In that study, two of the physicians tried to minimize their use of the computer, and the third used it "conversationally" during the encounter.

In the NHRR study, there were differences in how each clinician used the computer. Some of the noticeable differences found in this study were: 1) Eighty percent of the *Keyboard* group (**Group B**) compared to 65% of the *Voice* group (**Group C**) responded "agree to strongly agree" to the statement "My medical records privacy would not be compromised by storing them on a computer." Ten percent of **Group B** and 15% of **Group C** responded "strongly disagree to disagree" to the above statement. 2) Seventy percent of **Group B** compared to 50% of **Group C** responded "positive to strong positive affect" to the question "What extent did the use of the computer enable your clinician to spend more time addressing your problems and concerns?" Five percent of

Group B and 25% of **Group C** responded "strong negative affect to negative" to the above question, while 25% from both groups responded "neutral." 3) Fifty-five percent of **Group B** compared to 60% of **Group C** responded "positive to strong positive affect" to the question "What extent did your clinician's use of the computer affect his/her attention to your problems and concerns?" Ten percent of **Group B** and 35% of **Group C** responded "strong negative affect to negative" to the above question while 35% of **Group B** and 5% of **Group C** responded "neutral";

What impact does computer technology have on the clinician providing preventive maintenance and/or education to the patient? In this study, computer technology had a positive impact on the clinician providing preventive maintenance and/or education to the patient. Eighty-five percent of **Group C** responded that the clinicians provided *"more than"* to *"extremely more than"* expected information concerning the treatment, illness and preventive maintenance. **Group A** and **Group B** responses were 70% and 65%, respectively.

What effect did voice recognition technology have on the patient/clinicians relationship? Voice recognition had a positive effect on the patient/clinicians relationship. The study indicated that 90% of the patient in **Group C** felt comfortable with the clinician wearing a microphone headset during their office visit. A lower percentage, approximately 60%, felt that the recording of the exam notes using a microphone helped them to better understand their medical problem.

Is the DragonDictate Classic Edition with the DragonMed add on adequate for use by Medical Professional? Yes. The DragonDictate Classic Edition with DragonMed Performed very well as input device for the EMR. After some continuos use the software

was able to adapt to the user's speech patterns and was able to improve accuracy to 96% within a semi-noisy environment. The average was 91.11%. The semi-noisy environment was caused by people walking in and out of the room, telephone ringing and music from the house next door. Using the Non-Supported Applications procedure described in the users manual, DragonDictate proved to be outstanding, as a navigational input/output device for Navy standards systems (CHCS), E-mail and the Internet.

Does the VR pilot project at NHRR meet the Military Health Service System open architecture requirements? Yes. In this study, the voice recognition software was interoperable with the MHSS LAN and other MHSS applications used over the network.

B. SUMMARY

The underlying premise of this thesis is that both the performance of voice recognition (VR) algorithms and the capability to implement them in real time, off-the-shelf or compact hardware, has advanced greatly beyond what was available in the past. VR technology has made enormous strides just within the past two years that can add numerous economical benefits to Military Healthcare organizations if implemented correctly. In this study, clinicians felt that the economical benefits decrease the time they spent documenting clinical encounters. In addition, the clinicians felt the lower documentation time increased the time spent providing patient education and patient care; in other words, improving time management increases productivity.

Manufacturers are producing user friendly Discreet VR packages that enable users to navigate and dictate into all Window based applications. The packages are as inexpensive as buying a top of the line keyboard or mouse. These VR packages are being

produced to support all of the major computing platforms' operating systems. These include MS Windows (version 3.x, 95, NT), UNIX, SunOS, OpenWindows 3.x, and even OS/2. With more of the computing industry focusing on multimedia, VR is quickly becoming the technology for the 21st century.

The DoD continues to move towards Joint Vision 2010 and the Command, Control, Communications, Computers and Intelligence For the Warrior (C4IFTW) concept. One technology that will play a major role in increasing the effectiveness and efficiency of the C4IFTW Command Center is a natural interface between humans and computers. VR technology is at an age where it can provide that interface, especially in the DoD Healthcare arena. Furthermore, within the next 5 years, after Continuous Speaker-independent systems become available, giving "orders" or inputting data into a computer by voice may be the normal way of doing business.

C. RECOMMENDATION FOR FUTURE RESEARCH

This thesis provides a preliminary study on the economic benefits of implementing VR technology on clinicians desktops in a Family Practice Department at a Naval Hospital. Additional research is required in the areas of Radiology and Psychology to exploit the economic benefits of implementing VR technology. As part of the strategic planning process, additional research is needed to determine the integration requirements for VR technology within the MHSS.

APPENDIX A. LIST OF RESEARCH PARTICIPANTS

Naval Hospital Roosevelt Roads (NHRRs), Ceiba, Puerto Rico

Voice Recognition (VR) Pilot Project Testers:

1. Lieutenant Commander Wesley Marquand, M.D., Family Practice Physician, U.S. Navy
2. Lieutenant Commander Richard Riggins, M.D., Family Practice Physician, U.S. Navy
3. Lieutenant Melody McMath, P.A., Acute Care Physician Assistant, U.S. Navy

Other NHRRs Participants:

1. Commander Pablo Pizarro, M.D., Family Practice Physician, U.S. Navy
2. Lieutenant Michael Green, Chief Information Officer, U.S. Navy

Naval Postgraduate School, Monterey, California

Follow-up Clinician

1. Captain James Scaramozzino, Ph.D., Psychologist, U.S Navy

U.S. Army, Presidio of Monterey, Defense Language Institute, Monterey, California

Follow-up Clinicians

1. Major Brian Cothern, M.D., Family Practice Physician, U.S. Army
2. Captain Michael Joyner, M.D., Brigade Surgeon, U.S. Army
3. Captain Bret Lesueur, O.D., Family Practice Physician, U.S. Army
4. Captain Mark Malzahn, P.A., Family Practice Physician Assistant, U.S. Army

APPENDIX B. NHRR VOICE RECOGNITION/EMR PILOT PROJECT EMR USER'S MANUAL

Naval Hospital Roosevelt Roads

Voice Recognition/Electronic Medical Record

Pilot Project

EMR User's Manual

Prepared By: LCDR Richard Riggins

NOTES:

Table of Contents

1. Introduction

This manual is intended to answer the most commonly asked questions about the MS Word based Electronic Medical Record (EMR) that we will be using in our Voice Recognition Pilot Project. The purpose of this project is twofold. First, we want to demonstrate that an electronic version of the patient chart is not only feasible, but also much more useful to the clinician in his daily practice than our current paper-bound system.

Secondly, we are trying to emphasize that the interface the clinician uses to enter information into this electronic record should be as natural and easy to operate as possible. What can be more natural than speaking? Of course, until we are able to provide voice recognition technology to all clinicians at NHRR, feel free to utilize the EMR technology and enjoy its benefits. Your knowledge and input is vital for the success of this pilot project.

Our EMR is a simple document file in MS Word, the Windows based word processor on your PC. We have taken advantage of many of the automated features in Word that will help us become more productive, hopefully without increasing the work load on the clinician. Custom macros, a table of contents, AutoCorrect and "Find File" features, along with many other Word capabilities, make this a powerful tool in the clinician's desktop workstation.

As I stated, though, this is a pilot project, and the EMR we have developed is not as sophisticated as off the shelf Computerized Patient Records now being developed. Our intent, however, is to use this as a vehicle to prove our point about Voice Recognition, and maybe show that a complete Computerized Patient Record package needs to be part of Navy Medicine's future as well.

Back to the manual. Besides the hard copy you have in your hands, it is designed to act as an "on-line help manual" as well. If you access the "EMRUSRMN" file on the "\\navhosrr-rown\ records\share" directory, you can use the table of contents as a navigation tool by simply double clicking your left mouse button on the page number next to the topic of interest. Modern technology will quickly transport you to that page. (Those of you using DragonDictate merely need to say "Go to Page {fill in the blank}" and it gets you there even quicker).

We hope you find this user's manual helpful in your clinical practice. Welcome to the world of automated clinical transcription, and thanks for taking part in this ground breaking project!

Richard Riggins
LT, MC, USNR
6/10/96

2. Initial PC Setup

A. Tools "Options" Section

There are a few Options that I would recommend you set up in your word processor to help you get going and keep things standard. Go to the "Tools" menu, and click 'Options' down at the bottom.

View Tab
1. Check Drawings in the Show box.
2. Check Hidden Text in the Nonprinting Characters Box

Print Tab
1. Check Update Links box. *Leave Update Fields Blank.*
2. Check Drawing Objects in the Include with Document box.

File Location Tab
1. Modify the Documents location to show the drive and path you use most frequently. Can be the Server drive if you use the EMR's frequently. (Server drive is \\navhosrr-rown\records).

User Info Tab
1. Type your name in the name field, i.e. Dr. John Smith.

The other tabs can be set up to your preference.

B. Customizing Toolbars and Menubars

A 'Charts' toolbar is attached to the EMR's template and it contains buttons that activate the macros that work in our EMR files. To see the toolbar, just right click on the toolbars above and click on 'Charts'. You will have to copy the "EMRMACRO.DOT" file from the \\NAVHOSRR-ROWN\Records\ Share directory to your hard drive first. Copy it to your "c:\Msoffice\Winword\ Template" directory. Then go to your templates organizer and copy the macros over to your Normal.Dot and you should be in good shape. Call me for help with this if you need it.

The Menu bar can also contain a "Charts" entry if you desire. The EMRMACRO.DOT has a macro called ChartsMenu. If you run this macro (go to 'Tools', then 'Macro', click on ChartsMenu and then "Run". It will do all the work for you. When it's done, you can click on "Charts" just like you can on the "File" or "Tools" menus above.

3. Overview of EMR

A. First Page/Patient Information

The first page of the EMR (example on facing page) contains the following information:

Patient's First Name Last Name
FMP/Sponsor Social
Rank (or FM Status)/Branch/Status

Patient's Birth Date, Patient's Gender

These 4 lines are actually "fields" that are updated simply by highlighting them and pressing F9 (you can also click your right mouse button in the field, then choose 'Update Field'). When you create a new record, the new chart macro sets everything up so all you have to do is press F9 and enter the information.

The patient information from the first page is linked to the footer on Page 2, the Summary of Care. Linking means that changes in the information above will automatically change the information in the footer. Therefore, **if the linked information in the footer is wrong**, don't change it in the footer. **Go to the source and change it there.** The footer will then update automatically

B. Table of Contents

Below the patient information is a Table of Contents. This lists the main sections of the EMR, along with a chronological list of the patient's clinic visits. With this list of notes, the Table of Contents essentially becomes a one page "Chart Review". It also serves as a chart navigation tool. **Double clicking the left mouse button on the page number by the entry of choice takes you to that page.**

SOAP note and Addendum entries created with the supplied macros all contain a "Heading 3" line that will be incorporated into the Table of Contents when it is updated. For example, the heading above, "B. Table of Contents" is a third level heading entry. Place the cursor there, and look at the left box in the formatting toolbar above. It should say "Heading 3".

Update the Table of Contents by pressing F9 or right clicking the mouse button in the table. Then choose "Update Field", and after that choose "Update Entire Table". Finally, Click on "OK" and your new note or entry will appear in the table. If you type your own note, be sure it contains a "Heading 3" line, preferably the assessment line, or else it won't become part of the Table of Contents.

John Anyone
20/123-45-0000
PO1/USN/AD

01 Jan 1901

Table Of Contents:

C. Problem Summary List

A Problem Summary List or "Summary of Care" should follow the Table of Contents. This List is fashioned (with some minor modifications) after the current PSL being placed in the paper charts. If you've never seen a PSL, just look on the left side of your paper charts, under the green insurance paper that is covering it up.

The PSL is in 'Table' format, which means that you hit the Tab key to move from one cell in the table to the next. However, hitting the Tab key at the end of a table may place a new line of cells in the table which may alter the appearance of the table. If this happens, just hit the 'Undo' key and all will be OK. You can also just move the insertion point directly to where you want it by using the mouse.

Of particular note, is the Allergies section at the top of the PSL. This is in red to catch your attention. It is also linked to the header sections of the outpatient clinical notes. Any allergies listed here will show up in the header on every page of the clinical records section. **If the allergy information in the header is wrong, make the changes in the PSL.**

There is also a watermark of the command logo on this page. This will print out in a subdued gray color when a hard copy of the PSL is printed. The watermark is linked from a picture file, which is relatively large. Linking here allows us to save a lot of disk space by not saving the same picture in every patient file.

For you Pediatricians out there, we have a pediatric immunization table that can be easily inserted in the vicinity of the PSL and printed out on the reverse of the hard copy version.

Medication or other types of flow sheets can also be developed and inserted in a similar fashion. Call me if you're interested.

Summary of Care

Allergies: *NKDA*

Problems

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Medications

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Surgeries/Hospitalizations

1.
2.
3.
4.
5.
6.
7.
8.
9.
10. Adv. Directive Provided:
11. Adv. Directive Returned:

Health Maintenance

Procedure:	Date	Results
Bld Type/Rh:		
HIV:		
RPR:		
G6PD:		
Sickle Cell:		
Mammo		
CXR:		
EKG:		
Pap Smear:		
Hemoccult:		
Prostate:		
Other:		

Immunizations/Date:

Flu	
Pneumovax	
Td	
PPD	
HepB	

Risk Screening/Social History

TOB:	
EtOH:	
Family History:	
Social History:	

D. Outpatient Clinical Record Section

This section contains the individual SOAP notes for the patient's clinic visits. There is a *macro, 'Insert Note', that will insert a blank skeleton SOAP note* with the current date and appropriate format for the date and assessment to be included in the Table of Contents. The cursor will be blinking in the chief complaint area, waiting for your input.

Notes can also be entered by using "canned text" with the AutoCorrect or AutoText features in MS Word. Or you can just start talking (typing for you guys stuck in the 20th Century). If you wish to start from scratch, don't forget to include the "Heading 3" line, preferably the assessment and date, or it won't show up in the Table of Contents when you update it.

An example skeleton SOAP note is below. The assessment line is in 'Heading 3' format so it will show up in this manual's Table of Contents just like in the real charts.

CC: Sample Note

Subj: Subjective information entered here.

Obj: VSS, AF NAD
Exam findings entered here.

E. 4/27/96 Assess: Sample Note

Plan: 1. Treatment rendered goes here.

F. Printing Notes

Just a quick note about printing notes. These notes are designed to print on the SF 600's created by the CHCS system. The page margins should fit in the central area on the sheet. When you print, though, don't print the whole file or the Patient Information/Table of Contents will print out first. **To print your note, place your cursor on the desired page, and click on "Current Page" in the "Print" option of the "File" menu at the top of the screen.**

Don't forget that a hard copy does need to be produced somehow. We haven't abandoned the paper-bound charts just yet, and they are still the official, albeit inefficient and obsolete, record of the care we provide.

For more information on advanced Word functions, see Chapter 7 of this manual.

4. Chart Conventions

A. File Location

The individual patient records are stored as unique Word documents on a File Server in MISD. This file server is protected so you will need to get your name inserted into the system before you will be allowed to access the EMR's on the Server. See Mr. Millan in MISD to be entered into the system.

Of course, what we accomplish by having the charts in a central storage place, is that they are accessible from any networked PC in the command. You can be in the ER, in your clinic or in the Medical Library, and the charts are sitting right in front of you in the computer. All of them. No more lost records (hopefully).

To get access to the Server, go to your 'File Manager' in Windows, and click on the network connection button. You will have to type in the name of the Drive (or click on it in the list at the bottom of the window). I would recommend checking the 'reconnect at startup' box if you plan to use this system regularly, as well.

The name of the Server is "\\NAVHOSRR-ROWN\RECORDS".

You can then access this drive from within Word. When you open the desired document, it will show up on your computer screen, but it has never really left the Server. You can then add your note or update the PSL. When you're done, simply 'Save' the file and the changes are added to the EMR document file.

Also, if you need to make a change to a note that has already been printed, a good habit to get into is to just make an addendum entry. This helps keep the two records as close to the same as possible. An 'Addendum Macro' and skeleton note have been provided for you.

B. File Backups and Archiving

Obviously, the integrity and security of the files is an issue. The Server permission technology is one way we will protect these documents. Another is our plan to backup the entire set of files every day on a tape drive.

A second plan is to Archive the information onto CD-ROM disks once per quarter. This will give us a permanent, unchangeable record of the file at that point in time. Therefore, if a significant problem with a file develops, we will have a mechanism to track at least when the change was made. And the chart can be revived to the point where the change was made, potentially saving a significant portion of the chart. Your help with our efforts to maintain a secure environment for this sensitive information will be greatly appreciated.

C. File Names

We have developed a relatively simple format to name our files. There are 8 characters in each filename. The first is the patient's Last Initial. This is followed by the Sponsor's Last 4, and then the patient's FMP. The final letter is the patient's First Initial.

For example. John Anyone, 20/123-45-0000 becomes A000020J for his EMR filename.

This format makes it relatively simple to find most charts. If you know the last name and last four, you should be very close to the chart when trying to open the file in Word.

By the way, the chart above, John Anyone, is the empty template file from which new ones are created. More on this later, in Section 5.A.

D. Footer Information

The footer on the PSL page contains the vital information for the patient. This information prints out at the bottom the page.

This information is linked from the first page of the document, and includes the patient's name, FMP/sponsor social, status, and birth date.

Also included in the EMR footer, is the filename for the chart. This will remain A000020J.DOC when you create a new chart. However, it should update automatically when you print the SF600 or PSL the first time. When you subsequently open the chart, the filename field should appear with the patient's unique code.

Changes to the footer should be made in the fields on page one, not in the footer itself. The same thing goes for the header allergy information and its origin in the PSL.

5. Creating New Charts & Updating Old Ones

A. Creating a New Outpatient Clinical Record

Ultimately, any given patient chart should already be created and waiting in the File Server for you to just enter your notes. However, early in this project you can expect that the majority of the EMR's will not yet be created. Creating the charts, however, is quite simple and takes only a minute or so.

The first step is to run the "New Chart" macro. This will open up A000020J.doc file (the template file for John Anyone), and prepare it for new data. The next step is to enter the patient's data into the fields on the first page. Press F9 to update the fields. You will be prompted for the right information, just follow the format of the example already in the field.

Once the data is entered, run the "File Name" macro to create the 8 character filename as previously described. *"File Name" must be run after "New Chart" for it to work correctly.* You will now save the file with its new filename by going to the "File" menu, and then 'Save As'. Simply paste (Ctrl-V) the new filename over 'A000020J' and hit return.

Now you can proceed to enter your clinic note or update the PSL or whatever you need to do. When you are done, update the Table of Contents and simply 'Save' the file and your changes are added to the new chart.

Note: be sure that the PSL footer has the right information before you close the document. It should update automatically if you have the chart open long enough after you enter the information on the first page. Now is a good time to go ahead and enter the patient's allergies if you know them, too.

B. Updating Existing Outpatient Clinical Records

If a change is needed or an error in the patient information in an existing chart, you can also easily update the information. There are two ways to do this - the easy way and the hard way.

The Easy Way: Merely type the correct information in the field. It should update the footer.

The Hard Way: After a new chart is created, the 'Filename' macro "locks" the fields on the first page which keeps them from being updated. To make a change, you will have to unlock these fields. This can be done by placing the cursor in the field to be updated (or you can drag the mouse over several fields if there is more than one change). Next just hit the Ctrl-Shift-F11 keys all together. Then you can update the fields by pressing F9. After you are done, lock the fields again by selecting them, and hit Ctrl-F11 *(no shift key this time).*

6. Locating Charts and Information

A. Find File Feature

The 'Find File' feature in Word is a powerful search tool. It is found in the "File" menubar at the top of the Word screen. You can search the free text of the individual files for specific diagnoses, medications, etc. - essentially any text. While this may take a few minutes when the number of files grows, just think of attempting the same task with our current system!

To perform a search, you need to specify the drive to be searched, and any specific information you're looking for. For example, if you want to search drive c: for John Anyone's EMR, go to the advanced search section of 'Find File'. There, specify Drive C: in the 'Location' tab, and click on 'Include Subdirectories'. Then go to the 'Summary Information' tab and type "John Anyone" in the "Containing Text" section. Click on OK twice and your search will commence.

7. MS WORD FUNCTIONS

A. Heading Levels

Heading levels determine which text is included in the EMR's Table of Contents. Our Tables are set up to include heading levels 2 and 3. The patient's Name and Social are Heading 1 entries, but that's always on the first page and not really necessary for the Table of Contents.

Heading 2 Items in the EMR include the following section titles:

- Summary of Care (PSL)
- Pediatric Immunization Table (if included)
- Outpatient Clinical Records

Heading 3 items are in the individual notes and addendum entries the clinician makes. Of course, you don't want the whole note with a level 3 heading, or it will all show up in the Table of Contents. The convention for the macros used in the EMR is as follows:

- SOAP Notes - The assessment line has the date of the visit next to the assessment. This line is a Heading 3 entry and will show up in the Table of Contents.
- Addendum Note - The first line is a Heading 3 entry, and has the date and title Addendum.

The rest of the text in the notes should all be "Normal" text. The box on the left in the Formatting toolbar above tells you the heading level of the text next to the cursor. **Changing a heading level is very easy. Merely place the cursor in the text to be changed, and click on the drop down arrow in the formatting box above. Scroll to the heading level desired and click on it.** The entire paragraph corresponding to the cursor will change to that heading level. The appearance may change somewhat, and you can manipulate that with the Font and style boxes above as well.

B. AutoCorrect and AutoText feature

MS Word has two helpful features that help you enter "canned text" very quickly. These are the AutoCorrect and AutoText features. They are somewhat similar in function in that they insert stored text or graphics when much shorter "code words" are used. AutoCorrect, however, will make the changes immediately after you type the code whereas AutoText allows you to make the change at a different time.

AutoCorrect will do things like change "adn" to "and" and "teh" to "the" as you type. But it's more sophisticated than that as well. I have whole SOAP notes ready to go as AutoCorrect entries by typing short codes like "ncold" (short for 'note - cold'). An entire SOAP note for a simple viral URI appears as soon as I type the above letters and hit the space bar. It will even allow you to insert graphics this way as well.

To create an AutoCorrect entry, all you have to do is type your text or create your graphic as you want it to appear in the Word document. Then highlight it with the mouse. Go to the "Tools" menu and click on 'AutoCorrect'. Type a short code word to represent the text or graphic to be inserted and click Add, then OK. *Make sure your code is easy to remember and that it isn't a real word or you may be inserting things when you don't want to.*

AutoText is similar to AutoCorrect, but when you type your code, you have to click on the toolbar button above. It's the one that looks like a small keyboard and a hand pointing to it. I prefer AutoCorrect since it's easier for me to enter the information in macros that way.

C. Macros

Macros are simple programs that help group repetitive keystrokes together. We have developed a handful of macros to help you create and use the EMR in an efficient and standard manner. The EMR macros and a short description of what they do follows:

File Creation Macros:

- NewChrt2 - opens file A000020J and prepares it to accept new information to become a new chart. The information fields on page 1 are highlighted and all you need to do after running the macro is hit *F9* and enter the information as prompted.

- Filenam2 - uses the patient information to create the filename for that patient using the convention described in Section 4.B. This macro also locks the fields on page one from changes that will affect the PSL footer area. After running the macro, click on the "File" menu, then on 'Save As'. Press Ctrl V to paste the new filename over the A000020J name from the template file.

Note Insertion and Navigation Macros

- Insert Note - Inserts a skeleton SOAP note into the Outpatient Clinical Records section. This note has the current date next to the assessment and these two items are included in the Table of Contents when it is updated.
- Insert Addendum - Inserts a skeleton Addendum entry at the top of the Outpatient Clinical Records section
- Go to PSL - takes the insertion point (cursor) to the top of the Summary of Care.
- Go to Table of Contents - Takes the insertion point to the Table of Contents.

There are several ways to run a macro.

1. Click on the Charts Toolbar button that corresponds to the macro.
2. Click on the "Charts" menu list and then the macro name desired.
3. Go to "Tools", then 'Macros'. Select the desired macro and click on Run.

The macros in these EMR's are designed to run from pretty much anywhere within the document. It shouldn't even matter whether you are in Header view, Normal view or Outline view. Nor does your cursor location within the document matter.

Note: If you don't see the "Charts" toolbar, click the right mouse button on the toolbars at the top of the screen. Then check on charts down at the bottom. An EMR file needs to be open to see this toolbar, however.

Also Note: If you don't see the "Charts" menubar at the top of the screen next to "Help", you need to run the ChartsMenu macro. It will set up the menubar as long as you have the above macros copied over to your Normal.Dot. This procedure is described in Section 2.B of this manual.

D. Updating Fields and Tables

The patient information fields in the EMR may need to be updated from time to time. The Table of Contents will surely change as we insert new notes. There are several easy ways to update fields.

The first way is to place the cursor in the field, such as the patient's status field on page 1, and press F9. *If you hear a beep, the field is probably locked and you need to press Ctrl-Shift-F11 to unlock it. After updating the field, Press Ctrl-F11 to lock it again.*

You can update the Table of Contents the same way. Press F9, and select update entire table (this enters any new Heading 2 or 3 entries and updates the page numbers at the same time).

The other way to update a field is to Right Click the mouse in the field. This will bring up and option box, and you can choose Update Field from there.

E. Graphics

Word allows you to enter graphics into its files along with text. This can be done either by inserting a picture or putting a picture into a "frame". A frame allows you to control the size of the picture a little better, I think, but you can do it however you would like to. Once a picture is in the file, you can edit it by double clicking the mouse on the picture. This allows you to modify the picture based on the specifics of what you are trying to draw.

These pictures can even be inserted as AutoCorrect options. Merely select the picture in the file, and then go to "Tools" and click on 'AutoCorrect'. Put in a unique code name for the picture, and whenever you type the code name followed by a space, it will automatically insert the picture for you.

One word of caution. These pictures do increase the size of the Word document files quite a bit. The larger the file, the slower it moves when you are trying to navigate around in it. I would recommend saving graphics for those very interesting or important cases, but please do make use of this feature.

8. Final Thoughts

This whole project is a work in progress. Feel free to forward any suggestions or criticisms of the EMR or Voice Recognition technology. We'll do our best to fix all the bugs and take the rest into account for the final analysis. All input is helpful.

Thanks again for using the EMR system and most of all, enjoy!

APPENDIX C. PERCEPTION QUESTIONNAIRE

Naval Hospital Roosevelt Roads

Voice Recognition / Electronic Medical Record Pilot Project

Perception Questionnaire
Prepared by LT Erik Threet
Naval Postgraduate School
Thesis Research

Rate/Rank_____ Position_____ Service_____

[Please circle answer(s)]

1. Please indicate your primary function:

    1. Physician
    2. Physician Assistant
    3. Nurse
    4. Healthcare Administrator
    5. Management Information Systems Officer
    6. Other (Describe)_____

2. Were you familiar with voice recognition technology before this demonstration?

    1. Yes 2. No

3. Have you previously used voice recognition software?

    1. Never
    2. 1 - 5 times prior to now
    3. More than 5 times prior to now

4. Did the voice recognition technology appear to be easy to use, as it was demonstrated to you today?

    1. Yes 2. No

5. In the demonstration, the voice recognition software's performance was:

    1. Excellent 2. Good 3. Poor 4. No
    Comment

6. Give your impression of the microphone headset's appearance.

    1. Awkward 2. Natural 3. Easy to wear 4. Distracting

    5. Uncomfortable 6. Other_____

**** OVER PLEASE → ****

7. As you see it, what are the benefits of voice recognition as a computer interface in the clinical arena? **(check as many as necessary)**

    1. Cost and time savings
    2. Improved thoroughness and legibility of SOAP notes
    3. Reduce repetitive keyboard and mouse motions
    4. Increase time spent on preventive maintenance and patient education
    5. No benefit
    6. Other_____

8. As you see it, what are drawbacks of voice recognition as a computer interface in the clinical arena? **(check as many as necessary)**

    1. Staff training
    2. Equipment requirements
    3. Willingness to use
    4. No drawbacks
    5. Other_____

9. Regarding your impression of the voice recognition technology, would you say that:

    1. The voice recognition interface would shorten the length of the patient encounter and save the user a considerable amount of time.
    2. The voice recognition interface would slightly shorten the length of the patient encounter and save the user a small amount of time.
    3. The voice recognition interface would neither shorten or lengthen the patient encounter and the user work pace would stay the same.
    4. The voice recognition interface would extend the length of the patient encounter and require slightly more user time.
    5. The voice recognition interface would considerably lengthened patient encounter and require much more user time.

10. In your opinion, what are the primary drawbacks to the voice recognition system? **(check as many as necessary)**

    1. Microphone headset
    2. Recognition errors
    3. Dictating notes in front of patient
    4. Initial voice training
    5. None
    6. Other_____

11. Rate your overall impression of voice recognition as a computer interface:

    1. Positive
    2. Neutral
    3. Negative

12. Please provide any other comments about the voice recognition concept, capabilities, training, ease of use, etc.:

If you would like to provide additional input or discuss this thesis topic, please attach your business card or e-mail address.

Thank you for your participation!

APPENDIX D. PATIENT SATISFACTION QUESTIONNAIRE

Naval Hospital Roosevelt Roads
Patient Satisfaction Questionnaire

Prepared by LT Erik Threet
Naval Postgraduate School
Thesis Research

[PLEASE CHECK THE APPROPRIATE ANSWER ABOUT YOU]

1. SEX: Male [ ] Female [ ]

2. AGE: 18 - 35[ ] 36 - 55[ ] 56 - 65[ ] 66 - 75[ ] 76 - Higher[ ]

3. EDUCATION: Less than 8th grade [ ]Some high school [ ]
   High school or equivalent [ ] Some college [ ] College degree(s) [ ]

4. During the examination the clinician used _____ to document notes:

Pen/Paper [ ] Keyboard/Computer [ ] Voice Recognition [ ]

[PLEASE CIRCLE THE NUMBER THAT MOST CLOSELY CORRESPONDS TO YOUR OPINION]

5. How familiar are you with the capabilities and/or limitations of computers?

Not familiar	Barely	Somewhat	Familiar	Very familiar
1	2	3	4	5

6. How often do you use a computer at work or at home?

Never	Once a month	Once a week	Every other day	Everyday
1	2	3	4	5

7. Did the clinician give you as much information concerning the treatment, illness and preventive maintenance as you would have liked?

No information	Less than expected	Average amount	More than I expected	Extremely more than expected
1	2	3	4	5

8. How interested was the clinician in helping you?

Very Uninterested	Uninterested	Somewhat interested	Interested	Very Interested
1	2	3	4	5

** OVER PLEASE → **

[Questions 9 - 19 : Strongly Disagree - 1, Disagree - 2, Neutral - 3, Agree - 4, Strongly Agree - 5]

9. The clinician was competent and knowledgeable during visit. 1 2 3 4 5

10. I had time to ask all the questions that I wanted to ask today. 1 2 3 4 5

11. The clinician spent as much time with me as I would have liked. 1 2 3 4 5

12. The clinician listened to what I had to say during my appointment. 1 2 3 4 5

13. The clinician was responsive to my concerns. 1 2 3 4 5

14. I understood the clinician's explanation of my problem. 1 2 3 4 5

15. The length of time it took to be seen was reasonable. 1 2 3 4 5
(How long was your visit _____)

16. Overall, I am satisfied with the clinician I met with today. 1 2 3 4 5

If during your visit, the clinician used a computer to record his/her notes, please answer the following questions or else stop here:

17. My medical records privacy would not be compromise by storing them on the computer. 1 2 3 4 5

18. I felt comfortable with the clinician wearing a headset during my office visit. 1 2 3 4 5

19. The clinician's recording of the exam notes using a microphone helps me to better understand the problem. **(Skip If Not Applicable)** 1 2 3 4 5

[Strong negative affect - 1, Negative - 2, Neutral - 3, Positive - 4, Strong positive affect - 5]

20. To what extent did the use of the computer enable your clinician to spend more time addressing your problems and concerns? 1 2 3 4 5

21. To what extent did your clinician's use of the computer affect his/her attention to your problems or concerns? 1 2 3 4 5

Please add any additional comments you would like to make:

Thanks For Your Participation!!

APPENDIX E. IMPLEMENTATION INTERVIEW QUESTIONS AND RESPONSES

Thesis Interview
NHRR Voice Recognition Pilot Project
Interview of LT Rich Riggins
Family Practice Physician, NHRR

I want to help identify the "best of what is " about the VR implementation. I want to help you envision "what VR might be". My objective is to create a dialogue and to help identify a "shared vision". I then want to find ways to use that vision to move towards Voice Recognition "Innovation". I would like to find out what are the life-giving factors for the VR implementation, when it is perceived to be at its' best and to find out what's happening and why. My intention is to determine and describe the successful themes involved with the Voice Recognition project.

March 1997

I. THE PERSON AND THEIR JOB :

What is your job title here in this organization? Family Practice Physician.

How would you describe what you do to someone who isn't familiar with this kind of work? A medical specialist or doctor who sees patients without regards to age or organ system complaint. In simple words, we see kids, young adults, senior citizens, men, women with all types of problems. While not taking care of every problem we are the doorway (i.e. the primary care manager).

When did you first start working on this job? I first started working here in the summer of 1994.

With the Voice Recognition project? The VR concept came up in September 1995. We started moving forward with it in January 1996. We actually got the product April 1996.

How long have you worked for this organization? I have worked here for three years.

What other jobs have you had in this organization? Some of my collateral duties include: working in the emergency room; teaching advance word class; preempting IDCs and PAs in the acute care clinic and help them see patients.

II. THE WORK

How does your job fit into the VR pilot project process? It is a way for me to document my clinical encounter. We only have to family physicians using it in the department. It has not been a department wide project, its more of a individual project

where just 2 of us have tried to use it to obtain better quality patient notes. Also, we wanted to see how the voice interface would work in a clinical environment. I saw it as a tool to transcribe notes rather than write them. The voice recognition fits with my job, there are some limitation but I have been able to effectively apply it using a word processor. It is a very affective tool for me and not a great hindrance in the clinic. Also, I use it for SOAP notes, Email, navigating through CHCS, ordering x-rays, PowerPoint presentation and memorandums.

What would help you to do your job better or help you get your work done? I think VR is a good product, it needs more continuous speech capability with better accuracy. If I could literally dictate into the computer and have it typed an accurate note that would be ideal. That is an endpoint we are all striving for. We had to start this project from scratch. I think if given more support and folks who know what their doing and not just stumbling like I have, the program will be more beneficial.

Where would that support come from? It has to come from the command level and from the MIS department. The VR program requires dedicated support if your going to implement it command wide. I don't see us implementing this command wide with our current MIS staff because they are over worked. There have been a lot of little bugs with the hardware and software that you find in any project like this. If you had one or two people dedicated to support the program (mainly hardware) everyday, then you would see a rapid return on your investment.

What was the purpose of this VR Pilot Project? This test was to determine if Voice Recognition was adequate tool for clinical transcription.

III. SUPERVISION

Who is your supervisor? My supervisor is Dr. Pizarro the Department Head of the Family Medical Center.

How frequently do you communicate with your supervisor? About VR Project? We communicate daily, every morning for a meeting. Although not routinely, we often discuss VR issues at the morning meeting. Sometime we discuss it when passing in the hallway.

What kinds of things does you supervisor do to help you do your job? It not a whole lot that he does directly, he is a consultation source for medical question. He supports the project by allowing us to spend OPTAR money on computer accessories and printers. A for as direct support, while he is aware of the project, we have not required much accept just approval and knowledge about it.

In general, how much say do you have in the decisions that you supervisor makes? I have the opportunity to provide good input and it is often received well and acted upon. This project came from more of a command level decision making. We took it to the

Executive Steering Committee that's where the approval was given. But, the department head was aware. Also, my input is observed when provided here in the clinic.

In general, how well do you get along with your supervisor? Very well.

IV. TRAINING

What VR process training is/was available? Brief software tutorial and "on the job" training for the VR. We offer an advance Microsoft Word training class which will help people using the system utilize and maximize the macro capabilities.

What training have you received on Voice Recognition? Has the training been adequate/effective? Why or why not? This product, DragonDictate, which was demonstrated to us by a vendor for one a day. We had about 45 minutes to 1 hour exposure where he just demonstrated the product. There really wasn't a training session. My training was pretty much reading manuals and plying with it. We had no local training. It was very easy to use. It interfaced with what we were using, Microsoft Word, right out of the box. The main thing was building the voice macros which I found easy to create to do the specific things that we required for the electronic medical records, what we created in word, that was not a complicated process. To see the product and for us to make the decision that it would be worth our while to buy it and use it, I think it was adequate. But not from a training standpoint.

V. AFFIRMATIVE INQUIRY QUESTIONS

What attracted you to NHRR? Initial thoughts? This was the lessor of two evils, I mean I had a choice between Iceland, Guam and Puerto Rico. Puerto Rico was closer to the US so I chose it because of location. Also, the practice was important because I wanted a medium/small hospital base where I could continue do OB and deliver babies. This facility offers a full range of family practice. I think this billet offers me a more well rounded opportunity to practice medicine than CONUS based clinics would.

What did you first see in VR? I first saw the VR several years ago, I don't remember the specifics. I did not think of it as a viable alternative until the discussion came up regarding transcription for outpatient clinics. That's when we started looking at it and it sounded like it was much more viable than it has been in the past.

Can you recall a time when you felt most alive or most excited about your work here? Any specific projects which really awakened your positive spirit? (pick one and tell us about it) What made that project stand out? people? ingredients? what went into it? Outside of my clinical practice, this has been the only major project that I have been apart of that I consider truly innovative. Other things have just been status quo maintaining and satisfying day to day business. I see this project really pushing the envelope and for that reason it stands out. The most excitement I got was when we would

have a problem with the EMR or voice, and resolve it over time after trying various options. That was a good feeling. Outside of the project, it was delivering babies and walking away from the labor deck with a healthy baby and happy moms and dads.

What do you value most about yourself? ...your work? ...NHRR? I value this project. I am very proud of it. I value providing competent, compassionate care to my patients overall.

What has NHRR contributed to your life? ...to your profession? The Hospital has contributed some good clinical experience. I think some of our equipment and supply procedures are below standard. I felt as far as this project goes, they saw an opportunity and the command did provide computer hardware and software that have allowed me to do things today that three years ago would not have been possible. The command has been very, very supportive in that regard.

Tell me about a time in which you really experienced a partnership with this organization? The voice recognition project, the command has been very interested. They have stood back and let us do what we wanted to do with this project, and it has worked out well. We have a very neat little package that works. By allowing us to do what we think is best, the command have fostered that since of investigation and experimentation, partnership and we have been successful.

In your opinion, is there a difference between a Physician Assistant and Physicians that would inhibit/enhance one from getting more involved with voice recognition? I don't see a direct difference between the two other than possibly more demand on the Physician to see more patients, or more complicated patients, in a given period of time. If there was no improvement in the "time" factor of dictating vs. handwriting the note, fewer physicians might choose VR given this argument.

How is it that you are able to influence decisions or make things happen? with VR? I think the command is open minded to our input and it is requested. This whole project came out of a Captains call back in September 1995. I asked the captain if we could have outpatient transcription because we had PCs in place and we were networked together. I saw that as an opportunity to start moving towards an EMR. At least start typing notes and have the available over the network. With budget limitation and the inability to hire more people, we started looking at other alternatives and Voice Recognition came up. Every suggestion does not evolve into something like this project. But, the command is very open to suggestion. Other avenues to influence decision besides captain call are medical staff management and executive command management.

What groups are you a member of specifically related to VR? The Clinical transcription work group. The CO direct us to put a group together to investigate the alternative to transcriptionist in the outpatient clinics and make a recommendation to the steering committee. In January 1996, we did that and then Mike Green and myself took

over and followed through with the project. We included Dr. Marquand and LT McMath to help test the concept of VR.

How do you mobilize a consensus within a group when not everyone agrees? We were able to discuss pros and cons of all the options. Of course some people in the command were intimidated by a project like this. But, what we have to look at is satisfying a need within a limited budget. The intent was not for people to lose their jobs but to satisfy a need that was not being handled by the status quo. We really did not have any trouble getting to a consensus.

What do you see as the major strengths / benefits of VR? This is kind of a two edged sword because continuous speech systems are not available yet for speaking naturally. Just using your voice to interface with the computer is the ultimate natural way to interface things, moving that way is a step in the right direction. Keyboard is a throw back to the past, and I think it's designed to slow us down. It is not built for efficiency. I think if we continue to look at more and better ways to interface with the computers, we will get more out of the PCs. Discrete speech is usable is some case, VR will be an excellent tool when continuous speech becomes available. The benefits of using it here is using it with an EMR, you manage patients records by voice, and using VR speeds up the process. Also, the tremendous improvements in interfacing with CHCS through a Windows based emulation program was an unexpected benefit of the VR.

What is your personal vision for VR and where do you see the Voice Recognition program in the future? I see voice recognition software system that dictates the clinical encounter as it occurs without me having to stop and dictate again. I'm talking real time; talking to the patient and the computer is documenting the encounter as it happens. Right now we do things, and then try to document what we did. The most accurate way to document an encounter is one time, real-time not the current way we do it now. Then, I can be more efficient, see more patients and spend more time with my patient. That would make me happy, because I would not have to document things over and over again; literally a microphone hanging from the ceiling connected to the computer.

Can you give me one idea that you see moving us towards that vision? The first step is a computerized patient record. Because you need some standard to dictate into, I created our EMR way before we started the voice project. I think DOD Health Affairs and the military's Medical Departments are going to have spend a significant amount of effort and time devising that computerize patient record making it comprehensive, including ordering tests, result retrieval, and inpatient records and marry it up with voice recognition as the input interface.

VI. Additional questions

Who provides you with feedback about the Voice Recognition process? Is it adequate/are you happy with it? I do not receive updates from DragonDictate directly because I did not purchase it. I don't know if we received any information or updates.

The providers all talk to each other about the VR issues. The only other feedback was in the form of comments from demonstrations given within our command and at the Surgeon General leaders conference in August 1996.

Who asks you for feedback? Are the recipients satisfied with your feedback? Have you asked them? The command has received both informal and formal feedback from the project via demonstrations and reports that have gone all the way to the Surgeon General, Admiral Koenig. My impression is that those requesting feedback are satisfied with it, but I have not directly questioned them regarding this.

How are Voice Recognition projects conflicts/problems resolved? We call Lt. Green in the Management Information Systems department. Our project has received excellent priority response from the MIS department and their assistance/expertise has been outstanding.

VII. WRAP-UP

Do you have anything else to tell us that you think I might find useful/important in my study? Do you have any questions for me? What did you think about this interview? The system is very user dependent but this is by far the better way to document the encounter notes than scribbling in the record. Although, sometimes writing (not speaking out loud) is better when you need to note something that is sensitive and don't want passersby to inadvertently hear. Voice is a good way, but not the only way. I see voice as a hybrid system in the future along with keyboard, mouse and probably a pen based system.

Thesis Interview
NHRR Voice Recognition Pilot Project
Interview of LT Mike Green
Chief Information Officer, NHRR

March 1997

I. THE PERSON AND THEIR JOB :
What is your job title here in this organization? Chief Information Officer, NHRR

How would you describe what you do to someone who isn't familiar with this kind of work? Basically my responsibilities include the overall operations of information systems at this facility, that include all information systems, PCs, dumb terminals; basically managing, configuring, planning, organizing and procurement of IT/IS equipment.

When did you first start working on this job? I started working at this hospital in April 1994.

With the Voice Recognition project? We started working with voice recognition in April 1996.

How long have you worked for this organization? I have worked at this facility for three years.

What other jobs have you had in this organization? Some of my collateral duties include: Silver and Gold Audit Committee, Chairman Of Strategic Goal II, Chairman Of Workload Analysis Workgroup, and OOD Watch.

II. THE WORK

How would you use VR if it was implemented in your department? The process would be to use it for generating memorandum, correspondence and e-mail. Basically, the goal would be to go hands off the computer (no typing).

How does your job fit into the VR pilot project process? As the Information System Department, we are responsible for the configuration management of all computers in this command. Supporting voice recognition in the clinical setting requires my attention to make sure (1) as we are doing voice recognition that the PCs are capable of supporting voice recognition and that it is supported in a manner that is user friendly to the clinician. In addition, we want to make sure that the computers do not choke because of the RAM, hard drive or network requirement. (2) Making sure that once we go to a real voice recognition system, an we are using Computerized Patient Records that those medical records are maintained (i.e. secure), the servers are backup and the servers have enough processing power to handle the voice recognition system. In addition, ensure that we have the compacity over the network to support the high bandwidth requirements for large electronics medical records which may have images embedded or various other capabilities, as well as handling a large database.

What would help you to do your job better or help you get your work done? Additional personal to help provide support.

III. SUPERVISION

Who is your supervisor? My supervisor is the director for administration.

How frequently do you communicate with your supervisor? About VR Project? On a daily bases. About every other week to provide the status on how the project is going and what the next step is.

What kinds of things does you supervisor do to help you do your job? Supports me in requesting funding and/or additional personal through the command. Helps identify the vision of the feature of this command with voice recognition and electronic medical records.

In general, how much say do you have in the decisions that you supervisor makes? My supervisor relies totally on me for any decision that he needs to make that impacts the command on information systems.

In general, how well do you get along with your supervisor? We get along very good.

IV. TRAINING

What VR process training is/was available? There was initial training available from dragon systems Inc., but we opted not to take it because of procurement requirement and the additional funding required to bring them here. However, we had a comfortable feeling that we could learn it ourselves based on the demonstrated usability of voice recognition and the built in learning features with the DragonDictate product. Now that just DragonDictate, I can't speak for other products.

What training have you received on Voice Recognition? Has the training been adequate/effective? Why or why not? The training or exposure that I received from the vendor was very adequate, he showed us what it took to start up. The vendor was not selling training, their selling point was how easy it is to learn and use.

V. AFFIRMATIVE INQUIRY QUESTIONS

What attracted you to NHRR? Initial thoughts? As a progression from NMIMC where I received my initial primary training as a CIO, the next step was to work at a small or medium facility, this was the only facility available at the time and that's how I ended up here.

When did you first see in VR? I was aware of voice recognition back in 1990 through the Kurzweil project on in Jacksonville and other areas. The purpose of the project was to start voice recognition up in the radiology department and test it to see if it was a viable product. I do not know who was involved in the test but it was not successful because it was to slow.

Can you recall a time when you felt most alive or most excited about your work here? Any specific projects which really awakened your positive spirit? (pick one and tell us about it) What made that project stand out? people? ingredients? what went into it? The most exciting project that awaking my positive spirits was when I came into this command we only had basically 34 PCs and no network. We had the old ACCESS system which had its on network but it was for ACCESS terminals of which we

only had 12. I came in just as we started to implement the Composite Healthcare System (CHCS). Three months after I arrived we installed the network and the PCs, I had about 3 months to prepare the command for CHCS. CHCS is what really brought me alive, expanded our network, brought the Medical Open Architecture (MED-OA) LAN online. We now have 18 fileservers, two of which are CHCS and we have a network capable of supporting up to 520 drops (333 PCs and the rest for CHCS equipment).

What do you value most about yourself? ...your work? ...NHRR? What I value most about myself is my leadership style and my personality, because with this environment you have to be very flexible and give folks who do the job the autonomy to do their job. Basically, be hands off and just look at the operations and ensure that the various job are being completed and allowing the personnel to do the job and be the owner of their process. What I like about the job is the diversity, dynamics and challenge of it. What I value about the Naval hospital or the command itself is that it has giving me more than ample support to take this facility basically into the 21st century in being paperless and going to voice recognition. The command has giving me the support and resources I need to implement and move towards visions and goals that I set for the command.

What has NHRR contributed to your life? ...to your profession? By allowing me to move towards my visions and goals, I have learned more about my job and how to push Information System into the forefront with what's going on out there today with technology. (i.e. bringing in new systems, operating systems, hardware requirements etc..)

How is it that you are able to influence decisions or make things happen? with VR? To help influence decision of the command, I use the 5 year plan, which all directors and department head have input into. Then take that plan and ensuring it becomes apart of the strategic goals. Then convert all that into the Information System Department goals and objectives. Then set up six month goals and objectives and follow through on them. Once a goal is completed, additional goals are brought in.

Voice recognition was a the next step in taking the clinicians desktop and maximizing its capability. We put a PC on each clinicians desk, at first all they were doing was interfacing through the PC to the CHCS. It was just a replacement for the dumb terminal. Then as they were given software, they were ale to do word processing, e-mail, spreadsheets and other task that could not be done with a dumb terminal. From there we said how can we maximize its use and take I a step further for electronic medical records and voice recognition. We felt that the best interface to the electronic medical record was voice recognition because clinicians do not like to type. Through a combination of keyboard mouse and voice they become very proficient with the PC and that makes it that much easier to use.

What groups are you a member of specifically related to VR? The group was referred to as a Transcription Working Group. This group was formed to evaluate a question raised by a clinician in the Family Practice Clinic. The clinician felt that more patient could be seen if the command expanded transcription services to the Ambulatory

Clinical setting. To expand the transcription service would require additional transcription equipment and more transcriptionist to do the transcribing. It was determined by the working group, which was a multi-disciplinary team made up of nurses, doctors, healthcare administrators and transcriptionist, that it would cost the command to much money to hire more transcriptionist and expand the transcription system when we already had PCs out there. A transcriptionist salary is approximately $25,000 per year. The Dictaphone equipment for each clinician was $1000, plus a new transcription system would have been required to support this new requirement because the old system was antiquated, this cost would have been $ 10,000. The only people using the transcription system right now is the pathologist and radiologists, everybody else does it by hand. The capability of establishing voice macros to take redundant actions out and provide macros to do those redundant actions much quicker allowing the clinicians or physicians to make their own voice commands.

What do you see as the major strengths of VR? Provides much easier and better interface for the clinician after training for two or three weeks. As they use it, voice becomes that much more powerful, where they start thinking out loud what they want to do. For instance, "log on to CHCS" instead of going through several keystrokes and using a mouse, they say one word and CHCS comes up. Before it took two or three commands to get there, now it only takes one voice activated command. Voice is much quicker than hand, keyboard coordination.

What is your personal vision for VR and where do you see the Voice Recognition program in the future? My personal vision is that VR becomes the major interface into electronic medical records or computerize patient records. I see the physician/patient interaction being captured by VR from start to finish. Basically, when the patient comes in they tell the clinician why they are coming in, so the clinician can get the history off the patient at that time. VR actually picks up both patient and providers voices and discriminates against the two, so when the patient talks it transcribes what the patient is doing in the exact field it needs to be documented. The physicians saying OK, "Ms. Jones, I need to get a brief history of what's been happening to you for the past couple of days." When he says, "history" it automatically puts the system into history mode and then listens for the patient and transcribes the patients complaint. All the way to the point where the physician says, "what I would like you to do is prescribe", and as soon as he says "prescribe", it starts documenting the prescription. When the prescription is documented it is automatically sent to the pharmacy. The doctor doesn't have to put it in. The clinicians continues talking to the patient, "here's basically what I need to educate you about on your condition." When it hears the word "education" it puts down on the computerize patient records the education that the physician provided. So it captures the whole encounter. Plus whatever the physician has educated the patient on. When that record is complete and the interaction is done, you have a completed patient record with what the chief complaints were, the physicians physical exam was, what his diagnosis was, what prescriptions he provided and the education he provided to the patient all in one shot without the physician ever touching the keyboard.

Can you give me one idea that you see moving us towards that vision? Currently, we can start implementing VR as soon as we have every clinician on a PC that's powerful enough to support VR. Then have a standard VR package, whether it be dragon, Phillips, IBM or whatever the case maybe, for the clinicians to use, so when they move from one command to the next , all they do is load their voice record and macro into the system. They are ready to use VR at that PC wherever they move to. We need to have a standardized computer patient record that interfaces with VR. As we get smarter and commercial companies start developing smart systems, for example, when the physician says, "I'm going to prescribe to you this medication to you and I need you to go to the laboratory for a CBC," the system is smart enough to pickup the keywords and order labs or pharmaceuticals the physician needs.

VI. Additional questions

Who provides you with feedback about the Voice Recognition process? Is it adequate/are you happy with it? I have not received any updates from the company, I know that they are available on the WEB (Internet).

How are VR problems solved? They call an tell us about their problems and we try to resolve it. One of the problems we are having now is the server that we have our medical records on and we have a problem with our network. We have tracked it down to a bad network interface card out there which is slowing down the entire network. This makes it hard for the provider to put in the patients medical records into the PC across the network, because it is so slow. Time is everything and if the provider has to wait for a record to load from the server he's dissatisfied and he's calling about it. They are not aware of the problem because we just fount it within the past couple of days. When we resolve that, right now the interim solution was to put the patient records on to the clinicians PC's, then allow him to update our records down on the server. That's not the optimal solution but it works for now.

VII WRAP-UP

Do you have anything else to tell us that you think I might find useful/important in my study? Do you have any questions for me? What did you think about this interview? The future PC's in information systems is voice activation/voice recognition. It's moving that way. If you look at the systems that are put out by many of the vendors, they already include a sound card with voice capture capability and microphones. They see it as the future and they are trying to sell us systems with that capability.

Thesis Interview
NHRR Voice Recognition Pilot Project
Interview of LCDR Wesley Marquand
Family Practice Physician, NHRR

March 1997

I. THE PERSON AND THEIR JOB :

What is your job title here in this organization? Family Practice Physician.

How would you describe what you do to someone who isn't familiar with this kind of work? I provide extensive primary care to families not limited to organ system, age, sex or gender. We do a full range of care from routine to acute, pediatrics to deliveries, 1st assistant in surgeries, and minor surgery in the clinic.

When did you first start working on this job? I have work here for 2 years. I have been a family physician since June 1994, I was a GMO from 1990 to 1992 and finished my residency in 1994. I have a lot of primary care experience.

With the Voice Recognition project? I first started with VR in April 1996, almost a year ago, but I have not used it consecutively. We had problems with PCs here. My old PC crashed so I was down for about 4 months. I have started using it again but I am not up to full speed were I was prior to loss of my PC.

How long have you worked for this organization? I have worked here for three years.

What other jobs have you had in this organization? My other jobs include: Chairman of the Family Advocacy committee, Chairman of Medical Review Committee, Chairman of Ambulatory Care committee, Member of Executive Committee, Member of performance improvement committee. I have others, in all they take up about 30% of my time. We did an availability study and my time used for patient care was 4.4 hrs. a day.

II. THE WORK

How does your job fit into the VR pilot project process? When it is running and I have time , I will sit down an dictate notes and patients charts. I am starting from scratch. I use it for generating memos. The others clinicians are using it to give the computers commands, for example they order labs and x-rays for patients using voice commands in CHCS. I am not doing that right now because I have not reloaded those macros. Right now the VR is not helping me out because I am on the low end of the learning curve and it slows me down more than anything.

What would help you to do your job better or help you get your work done? I think you need have to meticulous support for your electronic gear (hardware and software). As a physician you have only 15 minutes for turnaround of a patient, we don't have time to be tweaking the hardware or adjusting the software. I don't want to spend a lot of time making templates and macros at this point , mainly because I don't know how. If I new how, it would not be a big deal. But the thing is we don't have the training in place to get you over the learning curve. This programs requires up front training and continuous on going support for VR software, local area network and the PCs. The biggest problem I had using the VR system was PC failures. Currently I use it for dictating memos only.

Where would that support come from? Management Information System Department

What was the purpose of this VR Pilot Project? To see if VR makes use of an Electronic Medical Record

III. SUPERVISION

Who is your supervisor? My supervisor is Dr. Pizarro the Department Head the Family Medical Center.

How frequently do you communicate with your supervisor? About VR Project? We don't communicate at all about the VR project.

What kinds of things does you supervisor do to help you do your job? I don't think he has any resources to make it better base on the things I perceive, as for as PC maintenance, software maintenance or training. He could give more time for patient appointments, that would help VR but not my overall mission here. By more time for patient appointments I mean change from 10 minute intervals to say 22 minutes intervals per patient because it takes me 10 minutes to dictate where I could have written it in 2 minutes.

In general, how much say do you have in the decisions that you supervisor makes? He would pretty much endorse everything because we are all family physician and have pretty much the same view and goals for the department.

In general, how well do you get along with your supervisor? We get along very well.

IV. TRAINING

What VR process training is/was available? No formal training.

What training have you received on Voice Recognition? Has the training been adequate/effective? Why or why not? We had the one time demonstration from a vendor, we have the manual and we have Dr. Riggins

V. AFFIRMATIVE INQUIRY QUESTIONS

How do you mobilize a consensus within a group when not everyone agrees? Logic and individualize problem solving.

What do you see as the major strengths / benefits of VR? Voice macros for CHCS

What is your personal vision for VR and where do you see the Voice Recognition program in the future? Eventually replacing handwriting notes or type communication and speeding up the overall process.

VI. Additional questions

Who provides you with feedback about the Voice Recognition process? Is it adequate/are you happy with it? Dr. Riggins, Lt Mcmath and myself. Yes it is adequate.

Who asks you for feedback? Are the recipients satisfied with your feedback? Have you asked them? Same as above.

How are Voice Recognition projects conflicts/problems resolved? I call Lt. Green in the Management Information Systems department.

VII. WRAP-UP

Do you have anything else to tell us that you think I might find useful/important in my study? Do you have any questions for me? What did you think about this interview? No.

Thesis Interview
NHRR Voice Recognition Pilot Project
Interview of LT Melody McMath
Physician Assistant, NHRR

March 1997

I. THE PERSON AND THEIR JOB :

What is your job title here in this organization? Physician Assistant and Assistant Department Head for Acute Care Emergency Department.

How would you describe what you do to someone who isn't familiar with this kind of work? I provide physician services to eligible beneficiaries. In the acute care clinic we

only see patients over 16 year old. We provide a range of care for anything from a sprained ankle, to diabetes, to chest pain.

When did you first start working on this job? I arrived here in June 1995.

With the Voice Recognition project? I first started using VR in September 1996.

How long have you worked for this organization? I have been here for 1 ½ years. I have been in the Navy for 19 years.

What other jobs have you had in this organization? Some of my collateral duties include: Pharmacy and Therapeutics Committee, Executive Committee of the medical staff. I am an ACLS instructor and the Director of the hospital corps screening program."

II. THE WORK

How does your job fit into the VR pilot project process? I use it for everything; charting, writing instruction and memorandums, anything I have to type I speak. It spells better than I do and I don't type very well.

What would help you to do your job better or help you get your work done? The thing that would help me do my job better with VR is greater speed. When commercial VR programs are more developed and distributed specifically to do health records, it will be a lot faster. This VR project is very good ,but it could be so much better if it was tied into some sort of database, where I could pull up all the patients that were only my patients.

What was the purpose of this VR Pilot Project? This test was to determine if Voice Recognition was adequate. Voice Recognition works, we're beyond that point. We need to maximize it potential base on its current technology.

III. SUPERVISION

Who is your supervisor? My supervisor is Dr. Pizarro the Department Head the Family Medical Center.

How frequently do you communicate with your supervisor? About VR Project? We communicate daily. We communicate on and off about the VR project.

What kinds of things does you supervisor do to help you do your job? Get the updates of the DragonDictate Programs.

In general, how much say do you have in the decisions that you supervisor makes? I think he would listen to what I have to say and act upon it. He is very supportive of VR.

In general, how well do you get along with your supervisor? We get along very good.

IV. TRAINING

What VR process training is/was available? I had some one on one with Dr. Riggins. He taught me how to put in the macro's. That was pretty easy.

What training have you received on Voice Recognition? Has the training been adequate/effective? Why or why not? There wasn't any formal training. The training or exposure that was provided by Dr Riggins was very adequate. The VR Programs itself is pretty self explanatory. You go through the tutorial / training for twenty-thirty minutes and the system learns your voice as you use it. If I knew more about Microsoft word program it would have been easier to use the voice recognition electronic medical record macros. Microsoft Word training is available but I have not in able to attend it because I would have to give up some patient care time.

V. AFFIRMATIVE INQUIRY QUESTIONS

What attracted you to NHRR? Initial thoughts? I had a choice between a ship and here. I chose Puerto Rico.

What did you first see in VR? I first saw voice recognition when Dr. Riggins installed it for me in October 1996. I had read some articles in some medical journals about dictation and voice recognition. All of the studies stated that people do better documentation, more thorough, include more information and more legible notes.

Can you recall a time when you felt most alive or most excited about your work here? Any specific projects which really awakened your positive spirit? (pick one and tell us about it) What made that project stand out? people? ingredients? what went into it? Combining the acute care clinic and family practice clinic, that is a very challenging project. Once this is completed, I think we will be able to provide better patient care. Right now most of us have access to the medical charts through the network. So when I see a family practice patient, I have access to their chart or vice-versa. We will have greater consultation ability because I am not a physician, I am still learning. The voice recognition network will definitely speed up things.

What do you value most about yourself? ...your work? ...NHRR? I value providing the highest quality of patient care to anyone who is eligible in a timely and caring fashion with the resources I have available here.

For the hospital I value the same thing because we are to take care of patients. If that becomes not the focus, then the patients go away and we don't have a job to do.

What has NHRR contributed to your life? ...to your profession? It has given me the opportunity to practice, and the tools to do that. Also, the hospital has provided me the opportunity to work with voice recognition.

Tell me about a time in which you really experienced a partnership with this organization? The voice recognition project, know other acute care or family practice clinic has this capability. I communicate through Email with other Physician Assistants, there is a lot of interest out there, but a lot of those people don't have computers capable of supporting voice recognition. I am very resistant to computers. I never used it for anything except CHCS until I received the voice recognition software. It makes using the PC fun. I don't type very well and with voice recognition you can create macros to use as shortcut.

In your opinion, is there a difference between a Physician Assistant and Physicians that would inhibit/enhance one from getting more involved with voice recognition? I am old an set in my ways. Most physicians are young and grew up with computers, they would be more comfortable with using computers. Also, older physicians are set in their ways, I mean they learned to how to do it one way and don't want to learn another way.

How is it that you are able to influence decisions or make things happen? with VR? I would go to the recognized experts in the command with my ideas.

What groups are you a member of specifically related to VR? I am one of the clinicians involve in the evaluation of the voice recognition program.

What do you see as the major strengths / benefits of VR? Dictating was initially slower than writing, even now it's sometimes slow, because of changes in the environment, but it is definitely more thorough. My handwritten notes don't say as much as my voice dictated ones. Macros, give you the ability to do extra test which you normally would not do because the initial exam is normal and additional exams would take a long time to write up. The Benefits of voice recognition is documentation, documentation, documentation.....and availability. Medically and legally documentation is very important, communication is very important, follow-up is very important and availability of that documentation is very important. When the medical records are in the PC its always available to those have a need to know. Another benefit is reduced manpower time because we don't have to send corpsmen or myself to find records for follow-ups or call the previous provider to verify a particular note. If you save time you save manpower dollars. I feel bad about it, but by can see voice recognition eventually replacing transcriptionist. If we dictate it we can proof read it right then, save it and its ready for a next provider if a follow-up is required.

What is your personal vision for VR and where do you see the Voice Recognition program in the future? My personal vision is when you join the Navy you will be given a credit card type device that will be your medical record. Providers will use voice

recognition to dictate medical encounter notes and store them on the card. This system would be "entirely paperless."

Can you give me one idea that you see moving us towards that vision? Money and people doing what we are doing, "maximizing the PCs to get the greatest potential." A willingness to change the way we do business and provide better quality patient care. We need people like Dr. Riggins, "hard chargers" to make the changes and pushed this new technology at the DoD and BUMED level in Washington D.C.. It is going to be people like us who are doing little project like this and as people here about how successful it was a they will get interested.

VI. Additional questions

Who provides you with feedback about the Voice Recognition process? Is it adequate/are you happy with it? The providers all talk to each other about the VR issues.

How are Voice Recognition projects conflicts/problems resolved? We call Lt. Green in the Management Information Systems department.

VII. WRAP-UP

Do you have anything else to tell us that you think I might find useful/important in my study? Do you have any questions for me? What did you think about this interview? I hate when I get records from other providers and I do not have a clue to what they are saying in the notes. That's a personal problem, I taught myself paleography so that know one could ever say they couldn't read my notes in records. Communication is very important in a medical profession. It is very easy at the end of the day, when you have been writing and your hand is tired, you start to leave out pertinent things that are relevant. Documenting the normal things is just as important as documenting the abnormal things. My voice gets tired at the end of the day but it's easier for me two speak.

Thesis Interview
NHRR Voice Recognition Pilot Project
Interview of CDR Pablo Pizaro
Family Physician, NHRR

March 1997

I. THE PERSON AND THEIR JOB :

What is your job title here in this organization? Family Physician. Department Head Family Practice which will be renamed to Family Medical Center as of April 7, 1997.

How would you describe what you do to someone who isn't familiar with this kind of work? The commercial definition is providing care for any complaint at any age. The clinical type definition is we are the main entrance of a very complex system that provide comprehensive primary healthcare to each member of the family.

When did you first start working on this job? I have work here for 5 years.

With the Voice Recognition project? I have not work with the VR project. I don't use VR, but I know that Lt. McMATH , Dr. Riggins and Dr., Marquand are using it for patient care. What I know from talking to them is that initially its slow. Once you get it trained it makes life a lot easier.

How long have you worked for this organization? I have work here for 5 years.

What other jobs have you had in this organization? My other jobs include: Chairman of Pharmacy and Therapeutics committee, Member of the Executive Steering Committee, member of Education and Training Committee and I help with the CME program.

II. THE WORK

Does your job fit into the VR pilot project process? Yes, very much.

What would help you to do your job better or help you get your work done? Staff support to handle patient loads so patients don't have to wait.

III. SUPERVISION

Who is your supervisor? Director of Clinical Support, we communicate daily.

How frequently do you communicate with your supervisor? About VR Project? Daily. We talk about the VR sometimes but its informally. He is aware of the project and supports it. Also, the Commanding Officer is very supportive of it.

In general, how well do you get along with your supervisor? We get along real well.

IV. TRAINING

What VR process training is/was available? There was no training available for me. I don't know exactly how the project was started, I wasn't involved in the initial planning. I would have love to be involved with the test.

V. AFFIRMATIVE INQUIRY QUESTIONS

What attracted you to NHRR? Initial thoughts? I wanted to come because I am from Puerto Rico. I first heard about VR 2 months ago. I thought it was a great idea that

would take lot of work because our computer are slow and these programs require power and Memory compacity.

When did you first see VR? When the project began in April 1996. My impression is that when you have a lot of patients waiting or an emergency comes up, VR is not a good thing to use. I have a friend out in the civilian sector that has used it. He said that it is a nice idea but it requires highly motivated people because of the computer systems they have. As of today, you have strong limitation of what you can do. You need templates and your own special language. It is not like normal speech that we do everyday. For something's it will work, for example procedures that you do on a regular bases (i.e. PAPS and Vasectomy notes). When you have a variety of things then you will get behind. If you use it to see the same type of patients over and over again, you build up a nice history of documented words which speeds up the process.

Can you recall a time when you felt most alive or most excited about your work here? Any specific projects which really awakened your positive spirit? (pick one and tell us about it) What made that project stand out? people? ingredients? what went into it? The merging of the Acute Care Clinic and Family Practice Clinic has been an exciting project.

What do you value most about yourself? ...your work? ...NHRR? I value my family first. Also, I value my job although our resources are limited and this hinders my efficiency. I never work some much doing administrative stuff, it is not an efficient way to utilize a doctors experience.

What has NHRR contributed to your life? ...to your profession? NHRR has given me more time to spend with my family. The opportunity to have good working hour so I can make better plans.

What groups are you a member of specifically related to VR? I was not involve on any group.

What do you see as the major strengths / benefits of VR? The benefit is that it helps organize the documentation. My personal impression is that it want improve patient care or reduce patient waiting time because it slows you down. Maybe in the future it might make a difference. The good thing about it is that you have clear note in the record, but you can do that by typing the notes and using templates.

What is your personal vision for VR and where do you see the Voice Recognition program in the future? A VR system with a strong computer capable of learning exactly how you talk, the language, accents and all the variants. You need some kind of a remote thing for your pocket (i.e. like Star Trek) or something that's of your uniform and picks up your voice.

Can you give me one idea that you see moving us towards that vision? I would want to be included in the implementation process, you should start at the deck plates with to juvenile command support. Insurer bad everybody is train when they initially arrived.

VI. Additional questions

Who provides you with feedback about the Voice Recognition process? Is it adequate/are you happy with it? How are Voice Recognition projects conflicts/problems resolved? Yes, I received feedback. It is very adequate. I believe that Dr. Riggins resolves most conflicts with the software.

VII. WRAP-UP

Do you have anything else to tell us that you think I might find useful/important in my study? Do you have any questions for me? What did you think about this interview? We need a VR system that does not require a functional highly motivated person. You need a system out of the box that has built in templates and macros and is ready to go. That way the most computer illiterate person can use it. When you have a system that is functional and working, I will use it because I am very interested in VR.

APPENDIX F. VR/EMR CLINICAL ENCOUNTER NARRATIVE PREPARED BY DR. JOYNER

Patient # 1.

The patient is a 25 year old black male, active duty member. His chart is placed on your desk with a chief complaint of coughing. On your way to the exam room, you scan the vital signs and notice the following: BP - 145/80, Pulse 90, Temp 100.5. Allergy: Erythromycin.

On entering the exam room, you notice a well groomed, well dressed man who appears his stated age. He does appear mildly ill, but answers your greeting with a smile and a polite "Fine, and you?". When asked for the reason for his visit, he states he has been coughing for several days, with gradual worsening of his symptoms. He was fine until the hurricane last week, when he had to work outside in the rain securing his work area, and he attributes his symptoms to this. He is now coughing up dark green sputum and is experiencing a little sharp right sided chest pain with inspiration. On saying this, he has a significant episode of coughing and produces a copious sputum sample. This is collected to be sent to the lab for gram stain and culture. No one at home has the same symptoms currently.

You begin to examine him, starting with his ears, which are clear. His nose is congested, with a clear discharge. Eyes are normal. At this time he states he is suffering from some significant congestion and sinus pressure, and has been experiencing some chills and sweats but has not taken his temperature. No sinus tenderness is elicited on palpation or percussion. Home treatment attempts have included Tylenol and Robitussin syrup. He admits to smoking approximately 1/2 pack of cigarettes daily. No adenopathy is appreciated on neck exam. When listening to the lungs, no rales or crackles are heard, nor are there any wheezes. Your working diagnosis is bronchitis and you are considering ordering Tessalon Perles, Bactrim for 10 days, and Entex LA.

While you are examining the heart, he states he has been meaning to come to sick call for a while because of an itchy rash on his back, but has been too busy at work. After noting a regular cardiac rhythm, with no murmurs or other extraneous heart sounds, you examine his back. There you find 3-4 pale, irregularly shaped lesions, the borders of which are slightly raised and red. The central areas of the lesions are more normal appearing. Your diagnosis is tinea corporis and you decide to treat with a topical antifungal. An exam of his hands shows no finger abnormalities or cyanosis.

After you answer a few questions about bronchitis and how it differs from pneumonia, you stress how important it is for him to quit smoking, and then explain your planned course of treatment as mentioned above. Your final instructions are for him to report to back to sick call in 1-2 weeks if the symptoms are no better, sooner if they worsen. You place him SIQ for 24 hours and encourage him to push fluids as you escort him out and make your way to the CHCS terminal to enter your orders.

Patient # 2.

The patient is a 21 year old white female, dependent spouse. Her chart is placed on your desk with a chief complaint of pain in sore throat, nausea, and vaginal discharge with odor. On your way to the exam room, you scan the vital signs and notice the following:
BP - 110/68, Pulse 75, Temp 98.4. Res. 20, Allergy: NKDA

On entering the exam room, you notice that the patient is sitting as if she needs to go to the bathroom. She appears like she is in a lot of pain, and states that she really needs to go to the bathroom and states that she has been going very frequently starting about five days ago. You have the nurse escort the patient to the bathroom and tell her to collect a urine sample. When the patient returns, you asked how do you feel now. She does appear mildly discomfortable, but answers your greeting with a smile and a polite "better". When asked for the reason for her visit, she states she has been coughing for several days, feels very tired and occasional right ear ache, and headache in temporal area with gradual worsening of her symptoms. She also states that she has had frequent urination and has a vaginal discharge with odor. She states that she is not taking any medication. States that she is not using any birth control pills and that her last cycle was 2 weeks ago. Last sexual intercourse was 2 months ago, use condom for protections.

You begin to examine her, she is alert oriented (times three) with no acute distress. She states that she has know history of urinary tract infection, inflammatory disease or surgery history. Ear are clear bilaterally, throat mild readiness, lungs clear, heart regular rate & rhythm. Pelvic exam: mild discharge, no cervical muscle tenderness, no masses, a wet mount slide was done and clue cells were present. Throat culture was negative. Urinalysis negative. Eyes are normal. Your working diagnosis is non specific vaginitis with bacteria vaginitis, you are considering ordering Flagyl for 7 days. You are also considering treating the upper respiratory infection with ceprecol lozenges, Tylenol and Entex LA.

Patient # 3.

The patient is a 20 year old female. Her chart is placed on your desk with a chief complaint of nasal congestion, coughing up yellow to green sputum. On your way to the exam room, you scan the vital signs and notice the following: BP - 120/72, Pulse 70, Temp 99.6. Res. 24, Allergy: penicillin

When asked for the reason for her visit, she states she has been coughing for several days, feels very tired, had diarrhea that started yesterday and occasional nausea without vomiting.

You begin to examine her, she is alert oriented (times three) with no acute distress. Ocular muscle are intact, Ear are clear bilaterally, no lymph node swelling, no sinus tenderness, lungs clear, heart regular rate & rhythm. Throat culture was positive came back positive. Your working diagnosis is rithnitis, you are considering ordering Tylenol, Robutussin and following up as needed. You are also notice that the throat culture came back positive for strep and you need to treat that also.

Patient # 4.

The patient is a 19 year old black male, active duty member. His chart is placed on your desk with a chief complaint of intermit fevers, nasal congestion, running nose, headache. On your way to the exam room, you scan the vital signs and notice the following: BP - 111/67, Pulse 73, Res 20, Temp 101.5. Allergy: Erythromycin, Penicillin.

When asked for the reason for his visit, he states he has been nauseated, vomiting and has had a itchy throat for three or four days, with gradual worsening of his symptoms. On saying this, he has a significant episode of coughing and produces a copious sputum sample. This is collected to be sent to the lab for gram stain and culture. No one at home has the same symptoms currently.

You begin to examine him, starting with his ears, which are clear. His nose is congested, with a clear discharge. Eyes are normal. At this time he states he is suffering from some significant congestion and sinus pressure on right side, and has been experiencing some chills and sweats but has not taken his temperature. Throat has moderate redness. Sinus tenderness is elicited on palpation or percussion. No adenopathy is appreciated on neck exam. Lungs are clear, no rales or crackles are heard, nor are there any wheezes. Your working diagnosis is Sinusitis and you are considering ordering Tessalon Perles, Bactrim for 10 days, and Entex LA, Increase fluids.

Patient # 5.

The patient is a 33 year old white male, active duty member. His chart is placed on your desk with a chief complaint of pain on the right side of his chest for approximately two days. On your way into exam room you notice his vital signs: BP 138/74, Pulse 80, Temp 100.2. No known Drug Allergies.

On entering the exam room, you notice a well groomed, well dressed man who appears his stated age. You notice that he is rubbing the right side of his chest with his thumb every 30 to 40 seconds. When asked for the reason for his visit, he states he has had a sharp pain in his ribs for the past two days. When he breaths in deep or bends to the right side the pain is reproduced. He also states that he can rub between his ribs and reproduce the pain. He also stated that he has been congested for a week and self treating with Tylenol and Psuedofed, an old trick his mother taught him.

Upon examination you find clear ears, slight nasal congestion, which is clear. Eyes are normal. No irregular lung sounds are noted. Upon palpation you notice that the patient slightly flinches when palpating between his 3rd and 4th intercostal spaces. You palpate the abdomen to find it normal. You ordered labs (CBC). The results of the CBC is high white blood count. The patient coughs while in the exam room and produces a thick green sputum. Please treat as appropriate.

APPENDIX G. VR/EMR CLINICAL ENCOUNTER NARRATIVE PREPARED BY DR. RIGGINS

NOTE I:

CC: Cough

Subj: 32 yo WM presents with complaint of 10 day history of cough productive of green, thick sputum. Admits to nasal congestion, bitemporal headache and mild post nasal drip. No fevers or chills, sore throat, nausea/vomiting or diarrhea. Has not tried any OTC meds yet. Cough keeping patient awake at night. TOB: none

Obj: VSS, AF, NAD except significant dry cough
HEENT: eyes clear, nose congested, TM's clear bilaterally, mouth moist, throat clear, neck no tender nodes, supple
Lungs: clear bilaterally, no wheezes, no rales
Ht: Reg without murmur, no rubs or gallops
Ext: no cyanosis or edema

9/17/96 Assess: **Bronchitis**

Plan: 1. Bactrim DS 1 po bid for 14 days, Entex LA 1 po bid prn, Robitussin AC 1-2 tsp q6 hrs prn severe cough, Tylenol prn
2. Push fluids, Rest, SIQ x 24 hrs
3. Provided Patient education and verbalized understanding: treatment plan, course of illness

NOTE II:

CC: Sleep Disturbance

Subj: 30 year-old BF with several week history of difficulty sleeping. Complains both of difficulty with falling asleep as well as with frequent episodes of waking up. Only getting about 3-4 hours of sleep nightly. Denies URI symptoms, fevers/chills, abdominal complaints. Also denies significant neuro complaints. Does admit to some significant appetite increase, anhedonia, tearfulness/moodiness and depressed mood in the last 3 weeks. Father died recently after long battle with colon cancer. Since then has had some trouble concentrating on things like balancing the checkbook. Some brief suicidal ideation 2 weeks ago, but no plan considered and no active ideation at this time. PMH: negative. PSH: Negative. TOB: none, EtOH: 2-3 beers nightly. Meds: OCP's. NKDA.

Obj: VSS, AF NAD, tearful,
HEENT: grossly clear

Lungs: clear without rales
Heart: regular, no murmurs
Neuro: grossly nonfocal peripherally, CN II-XII intact, Rhomberg negative, gait normal
MSE: poor eye contact, mood depressed, affect blunted.
No suicidal ideation, no hallucination or delusions. Serial 7's slow and 2 errors out of 5. Able to recall 3 objects immediately, but only 1 after 5 minutes. Speech slow but fluent, no flight of ideas, pressured speech.

9/17/96 Assess: **Major Depression**

Plan: 1. Prozac 20 mg qd, verbal suicide contract obtained from patient.
2. RTC 2 weeks for follow-up, sooner prn
3. Provided Patient education and verbalized understanding: treatment plan, course of illness

NOTE III:

CC: Headache

Subj: 1 day of frontal and nuchal headache. Does admit to some significant stressors currently at work and home. No photophobia, severe nausea or throbbing. No fevers. No history of migraine headaches in past. No current visual complaints. No sinus pressure or URI symptoms. No trauma. Has tried Tylenol without results. Allergies: NKDA. TOB: None. Caffeine: 2 cups coffee daily

Obj: Temp: 98.6, BP: 120/60, Pulse: 75 , NAD
HEENT: PERRLA, EOMI, no photophobia, sclerae clear, fundi benign, nose clear, mouth/throat clear, neck supple without nodes, nontender to palpation, no significant spasm appreciated.
Lungs: clear
Ht: Reg without murmur
Neuro: CN II-XII intact, nonfocal, intact peripherally
Patient reports much improvement in HA symptoms after Toradol IM.

9/17/96 Assess: **Tension Headache**

Plan: 1. Rest, Push Fluids, Motrin 800mg tid prn, warm compresses to neck.
2. RTC if symptoms persist or worsen, prn otherwise
3. Provided patient education and verbalized understanding: treatment plan, course of illness

NOTE IV:

CC: Follow-up Hypertension

Subj: Patient presents for routine follow up of hypertension. Currently taking Procardia XL 60 mg qd. Specifically denies chest pain, shortness of breath, edema or headache. Home blood pressure measurements are reading in the 150 systolic and 85 to 90 diastolic range. She offers no new complaints. Also taking Pravachol for elevated cholesterol. Last lipid measurement over 1 year ago. Currently following Step I diet religiously. Family History pertinent for father with CAD and MI at age 50, CABG x 2 by age 60.

Obj: VSS AF, NAD
HEENT: PERRL, EOMI, fundi benign, Neck without JVD or bruits
Lungs: clear without rales or wheezes
Ht: RRR without murmur, rubs, or gallops, distal pulses 2+
Abd: benign grossly
Ext: no clubbing/cyanosis or edema
Neuro: grossly nonfocal, peripherally intact

9/17/96 Assess: **1. Hypertension - stable.. 2. Dyslipidemia**

Plan: 1. Continue Meds, Procardia XL and Pravachol refilled.
2. Check Chem 7, Lipids (fasting)
3. RTC 3 months for follow up, sooner prn
Provided Patient education and verbalized understanding

NOTE V:

CC: Toenail

Subj: 2 week history of ingrown nail, right great toe. Has been soaking in peroxide daily. Had purulent drainage initially, but this has resolved. No trauma to toe, but wears narrow toed boots regularly. Also cuts nail very close. No history of similar problem in past. NKDA.

Obj: VSS, AF NAD
Ext: right great toe with obviously ingrown nail on medial edge. Moderate tissue inflammation and erythema but no purulent discharge on palpation. Exquisitely tender, however, especially distally.
Procedure Note: Informed consent obtained, Risks explained to include bleeding, infection, scarring, nail deformity and recurrence. Affected area on right great toe prepped with Betadine and draped in sterile fashion. Digital anesthesia obtained using 1% Lidocaine without Epinephrine, 4 cc used. Medial nail edge separated from nail bed with Iris scissors, and sharply removed using #15 blade. Bleeding controlled with pressure.

Dressed with Bacitracin and tube gauze. Patient tolerated procedure well, no complications, blood loss <5cc.

9/17/96 Assess: **Ingrown Nail, Right Great Toe. S/p Partial Unguinectomy**

Plan: 1. Keep clean and dry, watch for signs of infection. Elevate and apply ice prn for next 24 hours. Remove gauze in 24 hours, sooner if soaked. Motrin 800 mg tid prn for discomfort.
2. RTC 2 weeks for follow-up.
3. Provided Patient education and verbalized understanding: Packing nail edge and proper nail trimming reinforced.

APPENDIX H. VOICE RECOGNITION ELECTRONIC MEDICAL RECORD PROJECT DAILY VOICE RECOGNITION TABLE

Date	Words per Min	Correct Recognition	% Correct	Mis-recognition	% Incorrect	# New Words
9/23/96	23	2251	88	294	12	5
9/24/96	21	1664	90	185	10	2
9/25/96	23	1476	90	158	10	8
9/26/96	18	671	89	84	11	1
9/27/96	22	1774	87	255	13	8
9/30/96	23	1566	88	219	12	3
10/8/96	17	1774	89	227	11	3
10/9/96	22	2821	89	343	11	4
10/10/96	12	357	86	59	14	0
10/11/96	23	1213	88	160	12	4
10/15/96	21	1387	88	186	12	3
10/17/96	15	752	89	96	11	5
10/18/96	19	1703	87	256	13	1
10/21/96	22	977	89	126	11	2
11/1/96	21	1354	89	169	11	0
11/6/96	24	2010	89	259	11	4
11/7/96	29	942	90	102	10	0
11/8/96	23	1250	90	139	10	3
11/12/96	23	1954	91	193	9	2
11/14/96	23	636	89	76	11	1
11/15/96	22	1235	87	188	13	6
11/19/96	21	963	86	152	14	0
11/20/96	20	550	90	59	10	2
11/21/96	21	753	88	100	12	1
11/22/96	22	629	89	81	11	0
11/25/96	19	716	88	100	12	1
11/27/96	18	1024	89	127	11	4
12/2/96	21	452	89	56	11	2
12/3/96	19	131	92	12	8	1
12/5/96	25	292	90	33	10	1
12/6/96	28	810	88	119	12	2
12/11/96	20	728	89	89	11	3
12/18/96	20	526	89	68	11	3
12/23/96	26	599	91	61	9	0
12/26/96	31	504	89	65	11	2
12/30/96	27	983	90	112	10	4
1/6/97	20	292	92	27	8	0
1/8/97	25	382	87	51	18	1
1/9/97	23	502	92	44	8	1
1/10/97	23	1170	89	138	11	3
1/13/97	31	549	90	59	10	3
1/15/97	26	1147	90	131	10	3
1/21/97	31	487	92	43	8	0
1/22/97	31	473	90	51	10	1
1/28/97	21	836	91	80	9	1
1/29/97	26	789	91	71	9	2
1/30/97	27	203	90	23	10	0
1/31/97	29	928	91	89	9	1
2/3/97	22	405	90	44	10	1
2/4/97	24	907	91	86	9	3
2/5/97	26	1068	94	73	6	2

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